ELECTRONICS Australia

HIFI NEWS

OCTOBER, 1976
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BAUDOT-ASCII PROM

RHYTHM UNIT FOR ORGANS

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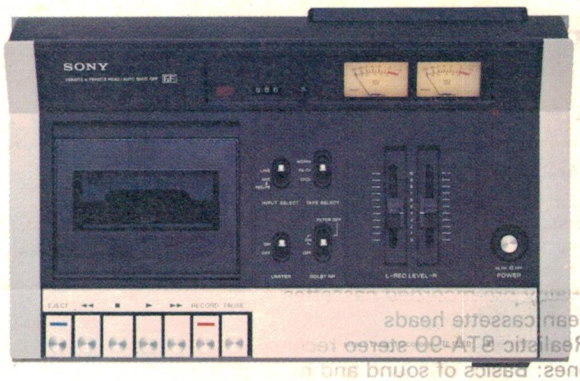
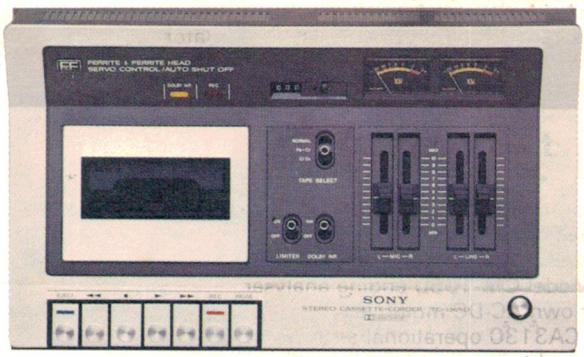


TC135SD $270*

Frequency response: 30Hz-15kHz with Sony Fe-Cr, Cr02. Signal to noise: 59dB at 1kHz with Dolby on. Wow & flutter: 0.1%

- Line/microphone selector
- Auto shut-off.
- Ferrite & Ferrite head.
- Tape selector for all tapes.
- Dolby noise reduction system.



TC136SD $320*

Frequency response: 30Hz-16kHz with Sony Fe-Cr, Cr02. Signal to noise: 59dB at 1kHz with Dolby on. Wow & flutter: less than 0.1%

- Line/microphone mixing
- Mechanical auto-stop
- FM pilot signal filter
- Ferrite & Ferrite head
- Tape selector for all tapes
- Dolby noise reduction system

TC138SD $420*

Frequency response: 20Hz-17kHz with Sony Fe-Cr, Cr02.Signal to noise: 64dB at 1kHz with Dolby on. Wow & flutter: 0.07%

- Line out level control
- FM pilot signal filter
- Memory counter
- Direct coupling system
- Line/microphone mixing
- Peak level indicator
- Ferrite & Ferrite head
- Dolby noise reduction system

* recommended retail

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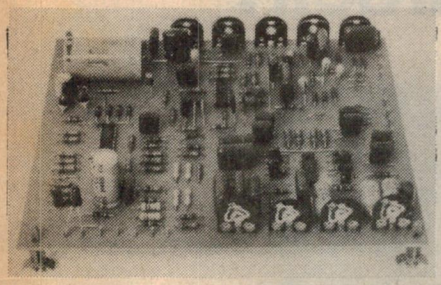
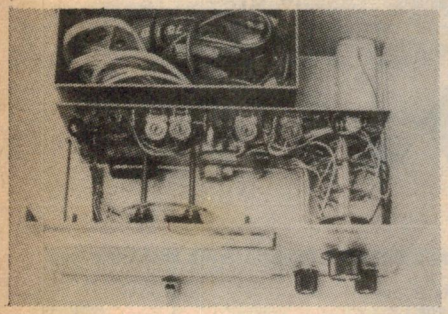
VOLUME 38 No 7



Developed in our laboratory, this auto rhythm unit should find particular appeal with those readers who have been building up the Playmaster 760 organ. This month we give details of the sound circuitry which is capable of simulating eight percussion instruments. See page 38.



There must be many Saturday-afternoon mechanics who wish that they had access to an engine analyser to do their own auto tune-up work. One unit worth consideration is the Heathkit Model CM-1050 Engine Analyser, which comes as a build-it-yourself kit. Our article on page 52 has all the details.

On the cover

The introduction of colour TV into Australia in 1975 provided the impetus to locally produce a new range of outside broadcast (OB) links. From STC Pty Ltd comes the OB7 Portable Microwave Link, a rugged, high-performance unit operating in the 7GHz band. The unit shown on the cover is currently in use with ATN-7 in Sydney. Inset depicts the evolution of our ASCII-Baudot translator program featured in this issue on page 84. The program commences as characters printed on a page, passes through the punched paper tape stage, and is finally stored in a PROM.

CONTENTS—OCTOBER, 1976

world of electronics and hi-fi

projects and technical

regular features

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Editorial Viewpoint

Are our brand names worth saving?

Involved, as we are, in the modular hifi field, we have tended to become progressively less sensitive to the inclinations and reactions of those people who still tend to think in terms of stereograms and traditional Australian brand names.

According to an executive of one of Sydney's leading retailers, people like that still exist in large numbers, and they still come into stores looking for the modern counterpart of what they've been accustomed to buying. Instead, they are faced with an array of hifi units, which have to be accommodated on table tops or shelves and interconnected with a festoon of cables and power leads. Out front there's an array of knobs far in excess of anything they have ever encountered before.

Most dyed-in-the-wool hifi fans tend simply to applaud this situation: "it's about time the mob was educated into our world, and our way of thinking"! Perhaps so, but there's one aspect of this education that I don't like.

My informant insists that there is a ready market for equipment that could be produced in Australia without too much effort, but that local companies are opting out because their managements are adopting the "easy-way-out" approach: "Let's buy something overseas and stick our name on it!"

While it may provide a short cut to a few bucks, it also forces yet more dollars out of Australian factories and into the pockets of overseas manufacturers, some large and well established, others obscure and transitory. And when later, if not sooner, the purchaser discovers that he has bought an overseas product, the credibility of the local brand name will have been thoroughly undermined, along with anything up to fifty years of institutional advertising.

I am not for one moment seeking to denigrate imported components, which nowadays dominate the local hifi scene. Nor am I deploring a natural trend from "lowfi" and "midfi" to hifi. It's just that I'm concerned about the apparent surrender of initiative—to the extent that a store executive says "we have to talk them out of a local product they want, into an imported product we can supply!"

While people have been variously happy, or unhappy, with the way colour television has blossomed in Australia, it has at least emphasised that planning, initiative and economic factors can combine to produce a logical sharing of the market between the local and imported product. And even if many smaller imported receivers carry local brands, the implications are less serious when it is common knowledge that the manufacturers concerned do have local factories, employing local people and local expertise, to produce other models in the range.

It is commonly tipped that colour TV sales will taper back from here on and the question arises as to what is going to happen to any surplus capacity. Are we going tamely to shut factories down or to seek second order activities—like family stereograms—to help sustain an indigenous electronics industry?

Neville Williams

ON SALE THE FIRST MONDAY OF EACH MONTH

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If he were around today we know he would use it.

Throughout his career as a composer and performer, there is no doubt that Franz Liszt went first class all the way. So it's logical to suppose, if he was around today, he would choose a chromium dioxide tape for recording and playback.
It is equally logical to suppose he would choose Agfa Stereochrom.
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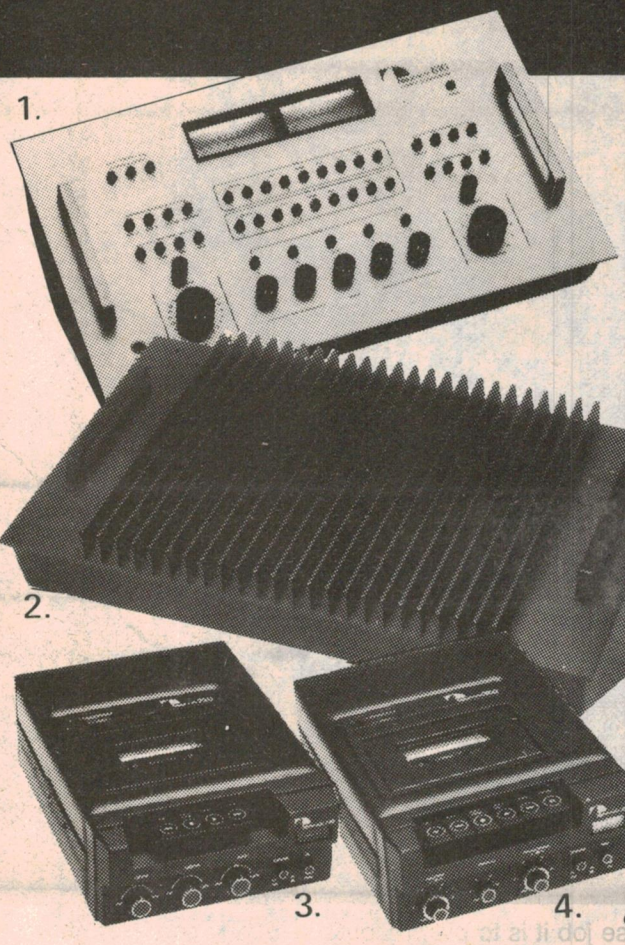

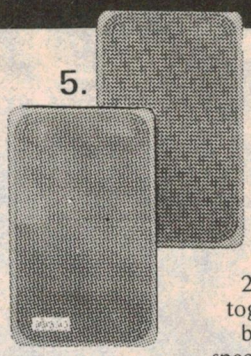

1. **NAKAMICHI 610.** This highly sophisticated and versatile Control Pre-Amplifier can enable you to obtain even better results from your existing Hi-Fi equipment. The 610 can truly become the heart of any sound system due to its many and varied inputs and its superb electronic specifications – An absolute must for the true Hi-Fi enthusiast.

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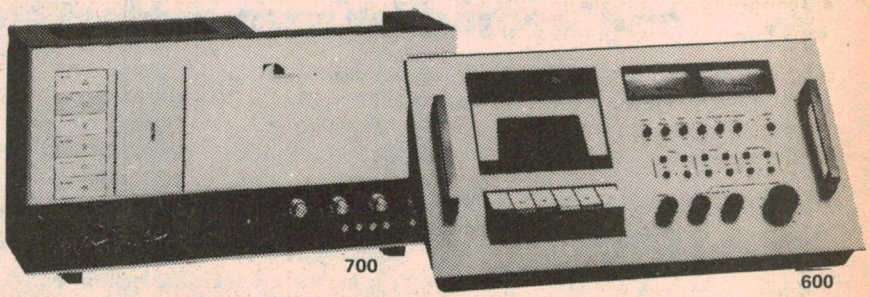
and of course the already familiar Nakamichi TT1000, 700, 600 and 550.

TT1000



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There are now eight new Sansui integrated amplifiers in the AU series, each with a different power rating and price tag.

If you're seeking to *involve* yourself in hi-fi, come hear us.

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Quadraphonic: Dead or alive?

Enthusiasts and the trade generally can be excused for feeling exasperated about quadraphonic sound. It's easy to write it off as dead, but then one has to explain some rather persistent signs of life. Looking at the corpse, some commentators are tipping that it's likely to be revitalised—this time without the conflict that laid it low the first time around!

by NEVILLE WILLIAMS

The quadraphonic story has been told too many times to need lengthy repetition at this point.

Sufficient to say that, a few years back, the hifi industry saw it as a technological revolution that could displace conventional stereo and create a bonanza for manufacturers of hifi hardware and software alike. So, around the world, they worked behind closed doors, played the patents game, refused to communicate and cooperate—and came up with two highly divergent methods, each with its own set of variants.

The hifi public, which was supposed to be intrigued and entranced by this new technological wonder—four signals in the one record groove—were harangued and confused by claims and counter-claims, with different interests upholding their own method and putting down all the others. As an industry exercise, it could not have been more effectively mishandled.

The hifi public was interested, to be sure, but the uncertainty created by the argument provided them with a ready-made excuse for not facing up to the practical challenge of quadraphonic sound: where to put the four loudspeakers in the average listening room.

As for the dealers, rather than see customers perched on the horns of a dilemma, it became a lot easier to point up the uncertainties of quadraphonic and to sell them back on to high quality stereo. And that's about where we stand now; you can buy quadraphonic hardware if you want it, and you may enjoy the resulting sound no end, but you'll do it despite—not because of—the average hifi salesman!

So runs "quadraphonic is dead" story and it would seem to have been reinforced for those who had occasion, recently, to look at the new range of JVC equipment at the local hifi shows.

JVC—the Victor Company of Japan—was one of the heavyweights in the quadraphonic battle. In collaboration with RCA of America, it developed and pushed the CD-4 system which made it possible to record and recover four distinct signals from the groove of a basically compatible long playing disc record. They faced and solved a lot of technological problems but, because their system makes the greatest demands in terms of hardware and software alike, it has been in the least favourable position to overcome inertia and resistance.

So while JVC have built and sold a lot of CD-4 equipment, they can no longer afford to have their hifi fortunes tied to it. They are spreading the message that, whatever your reactions to 4-channel, JVC is still 'The Right Choice" for hifi gear of any description.

In line with this, JVC's high fidelity catalog, handed out at the Consumer Electronics Show claims credit for the CD-4 quadraphonic system and other important technological developments but goes on to feature only 2-channel stereo components suited to the market as it now stands: high performance stereo receivers with power outputs ranging up to 180 watts per channel, attractively designed integrated amplifiers, AM/FM stereo tuners, record playing systems, a whole range of cassetts decks and record players, loudspeaker systems, graphic equalisers, headphones and microphones.

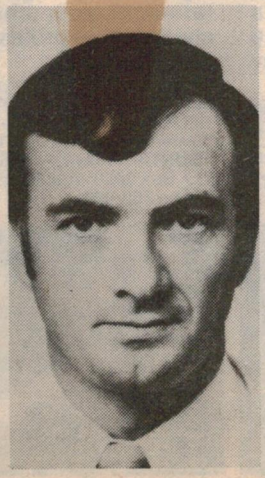
It's a pretty impressive array, much of it new.

It comes through strongly that JVC's considerable resources have been redirected into the 2-channel field until such times that the quadraphonic situation has re-developed. (For information on the latest JVC products: Hagemeyer (Australasia) B.V., 59 Anzac Parade, Kensington, NSW 2033.)

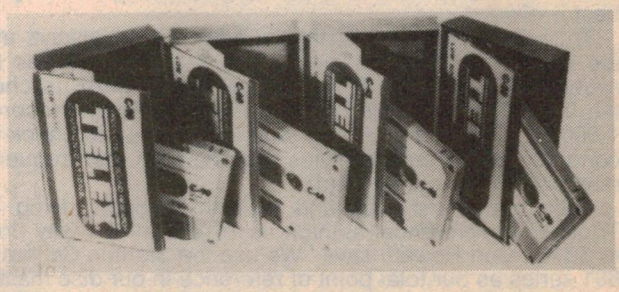
By sheer coincidence, about the time JVC distributors in Australia were emphasising 2-channel stereo, the agents for Shure passed over to us one of the last things we were expecting to see from them—a compatible stereo/quadraphonic cartridge designed for the CD-4 system.

Compatible cartridges are not new, of course, and quite a few of them have been released by other manufacturers. However, jealous of their reputation, climaxed in the V-15 Mark III stereo cartridge, Shure have for a long time shied

FROM AUDIO TELEX COMMUNICATIONS PTY LTD



Rod Craig



Mr. Rod Craig (left) General Manager of Audio Telex Communications Pty Ltd says that his company can now offer a range of compact cassettes designed specifically for high speed duplication. Available in C30, C45, C60 and C90, the cassettes feature anti-jamming mechanics and screwed boxes; they are available boxed or unboxed, with or without labels. Audio Telex have also been appointed as Australian distributors for Bogen sound products, well known in the field of public address, intercom and background music in the USA and Canada. Audio Telex is at 54 Alfred St, Milsons Point 2061, or at 828 Glenferrie Rd, Hawthorne 3122.

According to TRUTONE RECORDS..."The Stanton calibrated 681 series is our total point of reference in our Disc Mastering Operation"

"Carl Rowatti, Chief Engineer, adjusting the Program limiters prior to cutting a master lacquer".

Trutone can be described as a family enterprise . . . but what a family! Father Lou Rowatti is the President; Son Carl is Vice President and Chief Engineer; and daughter-in-law Adrianne handles the business end of the operation. They have great pride in their family, in their family's enterprise and in their products. That's why they insist on using the best — always.

Trutone Records in Northvale, New Jersey always uses the Calibrated Stanton Triple-E for A-B comparisons between tape and disc. They also use the Triple-E to check the frequency response of the cutter head (they'll record a 1,000 Hz tone and a 10 kHz tone twice a day to check the condition of the cutting stylus and the high end frequency response of the cutter head).

They make test cuts and play them back, using the Triple-E for reference, as high as 15 kHz all the way down to 30 Hz. Carl Rowatti says "We use the Stanton Calibrated 681 series as our total point of reference in our disc mastering operation. Everything in the studio is judged — and we think perfectly judged for quality—with this great cartridge".

Professionals can't afford to take chances with quality. That's why they depend on Stanton in their operations.

Each Stanton 681 Triple-E is guaranteed to meet its specifications within exacting limits, and each one boasts the most meaningful warranty possible. An individually calibrated test result is packed with each unit.

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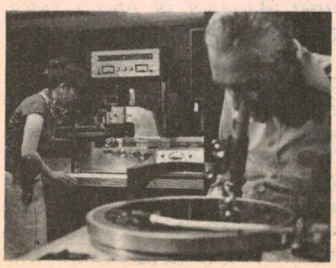
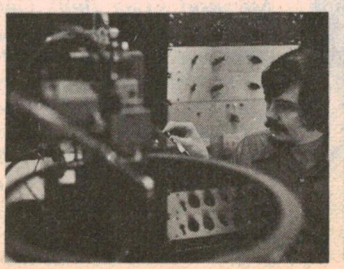
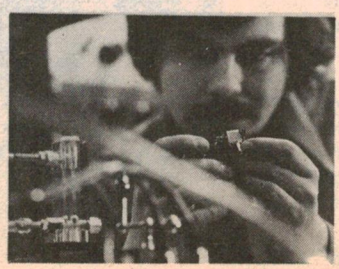
STANTON



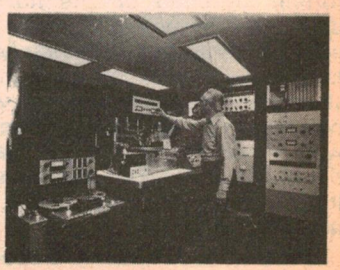
Lou Rowatti inspects a master lacquer, Adrianne checks the lathe.



Carl Rowatti adjusts the pitch computer on the mastering lathe.



Carl installs the Stanton Calibrated 681 Triple-E on the playback table.



Lou Rowatti (The Prez) adjusting the high frequency limiter in his cutting room.

away from the compromises which they feared they might have to accept in a compatible design.

At a seminar in Sydney a couple of years back, Ken Reichel, Shure's Chief Sales Engineer, claimed that the V-15 Mark III was very close to the design optimum for a practical stereo pickup, with low stylus mass, high compliance, very good tracking capability, the right kind of frequency response over the audible range—all this combined with a low tracking weight.

He claimed that the performance of a cartridge in the audio band (eg, up to 16kHz) would most likely be compromised by any attempt to stretch its passband to 50kHz. Almost certainly it would need to operate at a higher tracking weight and Shure was not prepared to sponsor a product that would involve trading off basic audio band characteristics for a CD-4 facility. At some time in the future they might come up with an appropriate design but until then . . .

Apparently that elusive day in the future has now arrived with Shure's announcement of the M24H compatible stereo/"quadriphonic" cartridge (their spelling). They claim that the M24H ranks with the finest stereo-only cartridge on the market, being "second only to Shure's V-15 Mark III . . . in stereo performance". The tracking weight penalty is very small: "an additional ¼ gram of tracking force".

In its further role playing CD-4 pressings, the M24H is credited with the lowest effective stylus mass yet for a quadraphonic cartridge (0.39mg), resulting in the highest trackability (25cm/sec at 30kHz) and the lowest discrete carrier distortion at a tracking force or 1 to 1½ grams.

A new hyperbolic stylus is used and a re-designed electro-mechanical structure that minimises high frequency loss and ensures a strong carrier output.

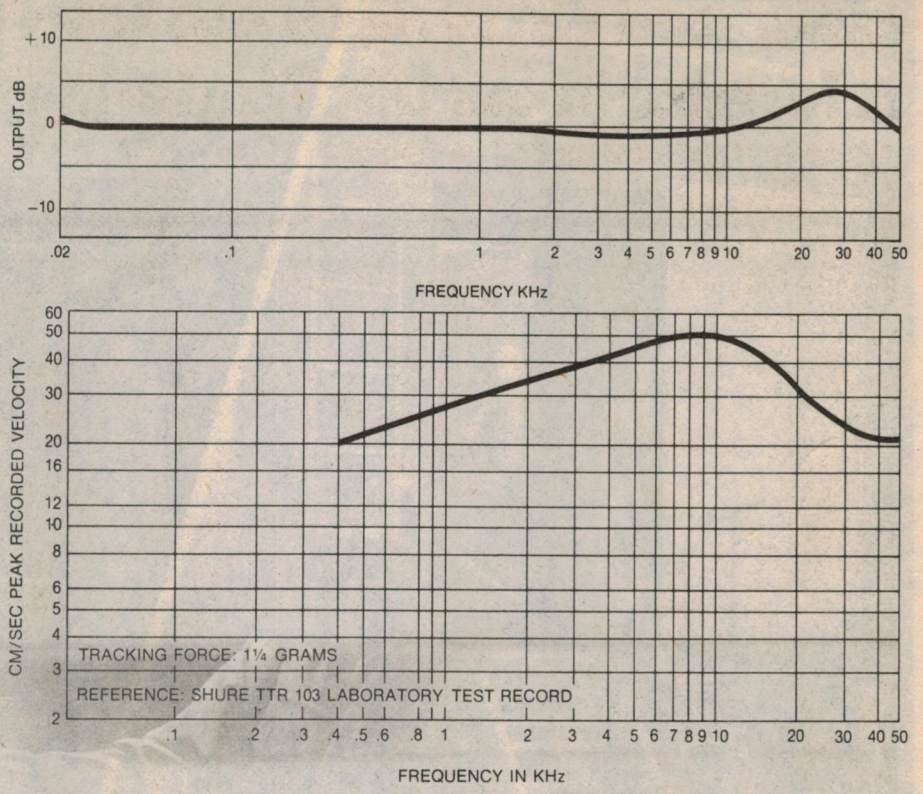
Rated audio band signal output is 3mV per channel at 1000Hz (5cm/sec), inter-channel balance within 2dB, separation 22dB at 1000Hz and load for discrete 4-channel applications: 100k in parallel with a capacitance of 100pF per channel, total. Performance curves for the cartridge are as shown herewith.

(Further details of the Shure M24H cartridge can be obtained from Audio Engineers Pty Ltd, 342 Kent St, Sydney, 2000.)

As distinct from the CD-4 "discrete" approach, the alternative matrix quadraphonic system seeks to minimise technological problems by matrixing (or encoding) the four input signals directly at audio frequencies in such a way that (hopefully) they can be unscrambled (or decoded) when the recording is played back.

While the matrix method makes very little extra demand on disc and cartridge manufacturers, it does suffer from cross-talk in that each channel ends up with a high or significant proportion of the signals that are supposed to belong to other

SHURE M24H FOR CD-4 QUADRAPHONIC



Shown at the top is the maker's published curve for the M24H which was substantially verified by our own tests. Tracking, as indicated by the second curve, was also verified, being somewhat below the top-of-the-line Shure V-15 Mark III but comparable with other premium grade cartridges. The M24H cartridge itself is pictured on the left.

channels. Separation could be up to 20dB or as low as 3dB, depending on the circuitry and channels involved.

Since those early days, Motorola, CBS, Sansui and others have come up with a variety of "logic" and "wave matching" circuitry to improve the subjective directional effect. By continually sensing the dominant signal and boosting it relative to others, the 3dB minimum figure can be pushed up to around 15 or 20dB.

This sort of signal processing can lead to much more convincing demonstrations on selected material, but it does not dispense with the basic arguments. Critics insist that, while the techniques make it possible to separate out a dominant signal or signal group. they can do nothing to improve the real separation between, say, four dominant signals occurring simultaneously, one in each channel.

While this is probably true, public acceptance of such a system depends less on laboratory tests than on the subjective appeal of typical recorded program material to typical listeners. If the appeal is high and the technology is straightforward, the ingredients for success are there, at least in the opinion of those who have a stake in the matrix system in one form or another.

So, despite the temporary lull, industry leaders see a resurgence of quadraphonic sound reproduction within the next few years, possibly to a dominant position. Interests like Sony/CBS and Sansui have little doubt that it will centre on the matrix system because of its (externally) simpler technology and because of the fact that matrix encoded recordings can be (and are being) broadcast by FM/stereo stations without breaching the technical parameters of their licence.

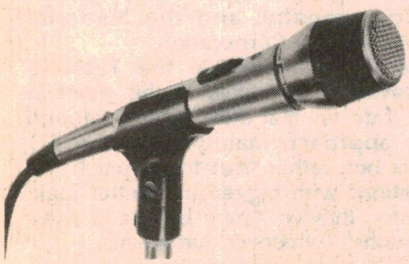
Both have even more sophisticated decoding and matrix systems in their labs but both are reportedly watching closely work being done by Tate Ltd, a British audio company, and the National Semiconductor Corporation.

Just what is behind the Tate/NS endeavour is not clear at this point in time. Tate say that they have developed their approach mainly from the SQ. matrix but, rather than try to patch the limitations with bigger and better logic circuitry, they've "gone back and fixed the maths"—whatever that means.

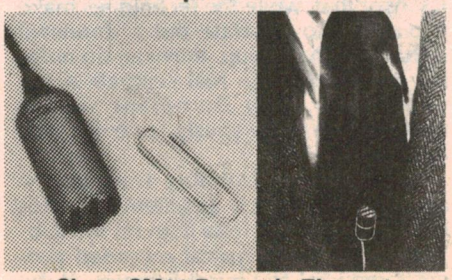
Joseph Dash, director of new product marketing for CBS is quoted as saying: "From what we've seen and heard so far, the Tate system is far ahead of anything in the marketplace or in development. If it can be successfully produced in integrated circuit form, it will bring

A complete recording studio in a van? For Mick Jagger, it's almost a necessity. Mick and the Stones can be inspired to produce their next hit anytime; but when they're on tour or vacationing, the best recording studios aren't always around the corner. For these moments of midnight inspiration, the Stones rely on their Shure-equipped mobile studio for the unmatched recording perfection they insist upon. Whether in a recording session or on stage, the Stones' Shure SM53, SM58, SM5C, SM33, and SM54 microphones are their assurance of consistent quality and natural sound.

Three more new Microphones from the Shure range.



Model PE52 Vagabond Close-Talking Microphone



Shure SM11 Dynamic Element Lavalier Microphone

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quadraphonic sound back to life".

Functionally, three chips would be required to process the normal output from the basic SQ decoder and, at last report, NS had the new chips to the stage where prototypes should be available about now. If everything works out as Tate and NS hope, it will return tens of millions of dollars over the next four or five years.

That's not a bad expectation from something that's dead!

Design target figures by the way are: 30dB separation in all directions; 0.05% total harmonic distortion; 70dB signal/noise ratio; DC controls for volume, balance and dimension; low external component count; full 4-channel hifi performance from 20Hz to 30kHz.

DIGITAL DELAY SYSTEM

Just in case there should be any shortage of 4-channel program material (there won't be) an American company Audio/Pulse have developed a stereo digital delay system priced at well under $1000 US intended specifically for the hifi market. It accepts the original stereo signals and produces random delay "echoes" to simulate those from an auditorium. By feeding these to a separate amplifier and to rear loudspeakers, in the manner of a quadraphonic system, a synthetic ambience can be obtained.

The Audio/Pulse unit presumably operates on the same principles as the "bucket brigade" device featured in our December 1975 issue. The incoming signals are translated into digital form and fed into a shift register which shuffles them along at a supersonic "clock rate", delaying them in the process. By sampling the signals at various points along the register, turning them back into analog form and recombining them, the end result is a synthetic multiple echo signal, rather like that obtained from earlier and less practical electro-acoustic or electro-mechanical devices.

Audio/Pulse claim that their new unit has a bandwidth of 8kHz and is free of the overtones and colourations of many such units as, for example, spring reverb. units. As such, it should appeal to hifi enthusiasts who want to enhance their mono and stereo recordings without having to accept the (allegedly) overdone effects in typical quadraphonic pressings.

COMPATIBLE RECORDS

So much for the hardware, which is where quadraphonic started a few years back, leaving software—the records—to catch up. If quadraphonic gets a new push, it may well be from the other direction, with software nurturing a consumer demand for new equipment.

When quadraphonic first made its appearance, record companies made quite a fuss about their 4-channel releases. The jackets were prominently branded and, as often as not, they were grouped in a special display in retail shops. They attracted attention, to be sure, but they also underscored any failure by the retailer to stock the stereo equivalent of a quadraphonic release, and vice versa. Talk about the records being compatible didn't help much either; if a customer wanted a particular pressing, he wanted that pressing, and that was all there was to it.

It was a replay of an earlier era when shops found themselves with a dual inventory of mono and stereo pressings.

A few months back, Britain's record giant EMI decided they'd had enough of the double inventory business. As an SQ licensee, they were not willing to drop quadraphonic so they opted for the other course: whenever an SQ pressing was available, it would become the standard one for release. If the marketing situation seemed to justify it, the record would be released as compatible stereo/quadraphonic, with the jacket suitably endorsed.

Alternatively, the same pressing might simply be marketed as stereo.

While the policy is relatively new in the formal sense, it would appear that matrixed pressings have been crossing the channel into Europe for some time under "Stereo" labels and, even in Australia, the occasional "Stereo" pressing has decoded so well as to suggest that it was no technical accident. Now of course, officially designated stereo/quad compatible discs are stocked and sold here as a matter of course.

In America, things have moved more slowly but, in the latest edition of "Audio", E. T. Canby reports that Capitol/Angel, the American arm of EMI, has also gone over to single inventory compatible. From now on, buyers of American Columbia pressings will find themselves with an SQ encoded disc in a great many cases.

Canby tips that the move by Capitol/Angel will, at the one time, confirm and establish the trend. Once again, the disc record will have re-shaped its destiny on the basis of compatibility, but now as mono-stereo-quad: one disc which can be played in three modes.

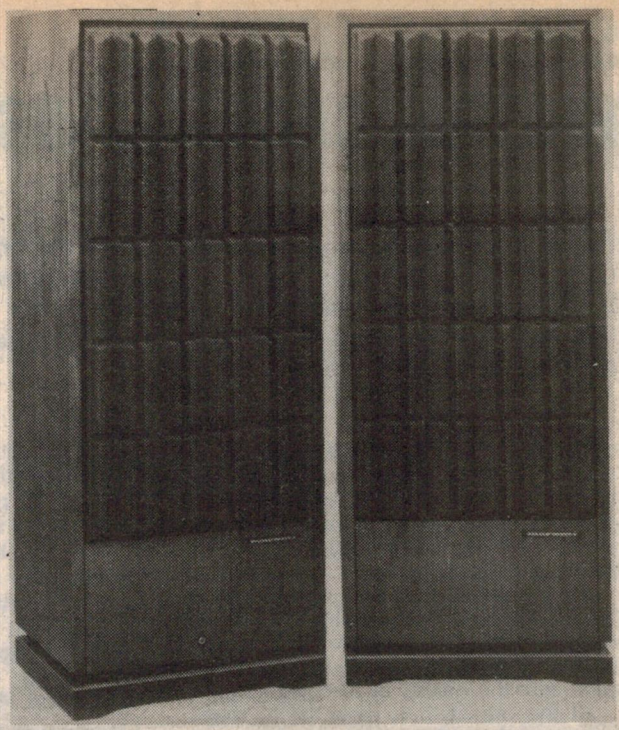
In the course of time, record collectors are going to find themselves with an increasing number of quadraphonic discs and perhaps with an inclination, next time around, to up-date to 4-channel equipment. The urge will be reinforced, for many, by the knowledge that an increasing number of FM broadcasts are also quad encoded. There may be some hang-up about SQ, QS, RM, &c, but, in the listening room, it all manages to emerge, at least, as "surround" sound.

Overall, the position looks promising for the matrix system in one form or various forms, simply because a progressive move to matrix is relatively painless at the software level. The future for CD-4 is another matter.

It could be rejected in the marketplace as "too hard", leaving JVC and RCA to lament.

Alternatively, a future 4-channel revolution could proceed beyond matrix to the disc system that offers intrinsic separation between channels.

The same could apply to 4-channel cassettes or their newer jumbo counterparts: they may be too specialised in the marketplace, or they may be taken up as the obvious way of getting full channel separation without the sum-and-difference convolutions of CD-4.



Auriema (A'Asia) Pty Ltd have recently introduced five new high definition loudspeaker systems featuring increased sensitivity and crossover controls allowing them to be set flat or to suit individual listening rooms. Pictured at right is the HD 88 floor standing model with a power rating of 200W program and priced at $550 each. Four "bookshelf" models HD 77, HD 66, HD 55, and HD 44, the lastnamed rated at 60W program and selling for $258 per pair. (Details from Auriema (A'Asia) Pty Ltd, PO Box 604, Brookvale, NSW 2100.)

SPECIAL QUALITY PRE-RECORDED CASSETTES

by W. N. WILLIAMS

Parker Recordings, in association with M7 Records Pty Ltd, have planned a pilot marketing exercise to assess the potential demand for high quality pre-recorded cassettes. Under the name "Spectra-Frequency" the initial release involves three local popular organ recordings and two popular instrumental double albums.

The new recordings are being made at normal traverse speed on high grade tape and, while costing more, should provide a standard of reproduction well ahead of what is normally available on pre-recorded cassettes.

Behind the Parker/M7 venture lies the whole question of the quality of present-day cassette recordings. Are they good, bad or indifferent? How do they compare with the quality of disc pressings?

At the outset, it is essential to make one very clear distinction—that between a premium quality recording that an enthusiast may produce in his own home, and what he might buy over the counter in pre-recorded form.

As we have said on other occasions, the quality which is obtainable in the home with a good cassette and a good deck is such that a carefully made tape is virtually indistinguishable from the source recording, in A-B listening tests.

The burning question surrounds pre-recorded cassettes, which many enthusiasts must face up to as an alternative to discs. What is their role and how do they compare, on the whole, in terms of quality?

Certain things are obvious, of course. Cassettes are more versatile in that they can be played in the home, in the family car or in a battery powered portable. They don't need to be stored and handled as carefully as discs and it is even possible to erase them and record a new program on the same tape.

Against this, they have their own mechanical problems, they carry a minimum of jacket information and they offer a more restricted catalog choice. They cost more than discs and, overall, would appear to be not as good in terms of playback quality.

In fact, there is a close relationship between cost and quality. With discs, once the presses have been set up, the unit cost is quite modest, allowing LP albums to be offered on occasions for under $2.00. Cassettes, however, have to be recorded, assembled and checked individually, using components that are more costly in total than a vinyl biscuit. The constant battle, therefore, is to get the price down to a figure that does not look too daunting alongside that of the equivalent disc.

In order to speed up the transfer from master tape to cassette tape, it is usual to run both at several times their normal traverse speed, transferring all four tracks in a single pass. This makes heavy demands on the mechanics, the heads and the electronics and, in particular, increases the audio frequencies by the same ratio. Assuming that the transfer takes place at from 8 to 16 times normal speed, the higher audio frequencies are stepped up to somewhere between 100kHz and 240kHz.

While such frequencies are not exceptional in terms of video technology, the price level at which the end product has to be sold is—and this includes the tape, which has to receive an RF signal, deliver an AF signal and cost not a cent more than it strictly has to. The manufacturers' first objective must be to satisfy the mass market; whether they can also meet the demands of hifi enthusiasts is another matter.

Such a statement may be highly controversial but it has a practical basis.

Disc production is a highly developed technology which is intrinsically capable of yielding wide frequency response, low distortion and a very low noise level. Whether a manufacturer achieves these results is not a matter of basic technology but of fairly routine quality control.

With cassette duplication, on the other hand, there is a sharp conflict, at present, between performance and price. A high quality cassette, recorded at normal speed on good equipment, can hold its own with any record. But, as the process is speeded up and cheaper tape is substituted to reduce price, quality falls along with it.

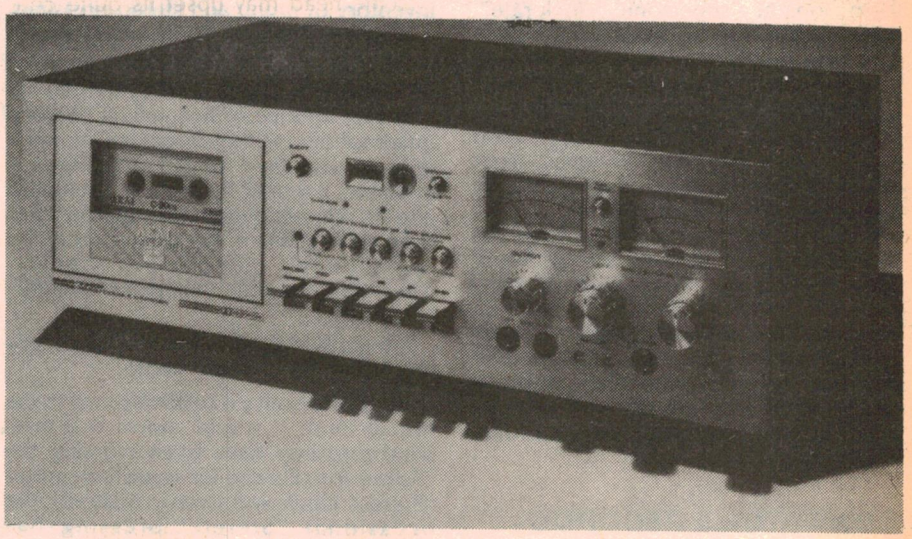
There are exceptions, of course: better than average cassettes and poorer than average discs. What is more, playback equipment and the enthusiast's own ears can influence opinion.

Typically, a prominence in the cartridge or speaker system around 6-8kHz can greatly exaggerate surface noise from a disc, and this is behind a great many of the comments one hears that "discs are noisy".

Tape doesn't suffer this problem but it can suffer from hiss and a loss of top audio response.

Thus a middle-aged listener may genuinely conclude that cassettes are quieter than discs and just as good in terms of response; just as genuinely, a younger listener may reject cassettes as "hissy" and lacking in sparkle.

My own reactions along these lines



With a modern cassette deck, a hifi enthusiast can make recordings virtually indistinguishable from the source, as judged by ear. The problem is to obtain pre-recorded cassettes of equal quality. The deck pictured is Akai's new front loading model GXC-74OD. Three heads make possible true off-tape monitoring, while a closed loop, double capstan drive system minimises wow and flutter. Separate Dolby circuits are provided for recording and playback and there is internal provision for accurate setting up. The meters can operate either as VU meters or for peak indication, while peak warning lights flash at the 7VU level.

have been sharpened recently by a series of listening tests involving direct A-B comparisons between commercial discs, commercial pre-recorded cassettes with and without Dolby processing, and high quality cassette dubbings made directly from sub-master open reel tapes. The inescapable conclusion was that, while high-speed pre-recorded cassettes may sound okay in isolation, and meet the needs of the bulk market, they fall consistently short of the equivalent disc played with a high quality cartridge.

From the viewpoint of the quality enthusiast, a problem therefore remains to be solved.

Curiously, the poorest cassette in the whole batch was one which had been Dolbyised, apparently with dire results to the top end. It reminded us of remarks we had seen in overseas journals indicating that Dolby-boosted highs can easily be attenuated again, "crushed" by a tape that lacks "headroom". When the recording is played back Dolby fashion, what is left of the highs tends to be attenuated further, leading to very dull sound indeed.

The lesson is simple enough: If Dolby is to be used and specified, it has to be used properly!

About 12 months ago, Convoy, in association with Goldring released their Contata series of special quality cassettes, employing Dolby-B but also recorded on TDK tape. Broadly, the Contata cassettes have received good reviews, but in isolation, and without the opportunity for comparison with their disc counterparts. When making the cassettes available to us for review, Malcolm Goldfinch, Managing Director of Convoy, indicated strongly that their release represented a conscious effort to offer customers an above average product from the viewpoint of playback quality, directed initially to the popular and drive-time market.

The new "Spectro-Frequency" cassettes are something else again, largely reflecting the personal interest of Parker Oakes of Parker Recordings and Ron Hurst of M7 Records. They go the whole way, in terms of quality, by being recorded directly on top quality cassettes at normal playing speed. Since they are copied from a high quality 15ips submaster, they should readily stand comparison to a top quality disc pressing of the same material.

When the project was first envisaged, Parker Oakes spent many hours personally evaluating blank cassettes and, while there were many candidates and many excellent cassettes available, his choice finally fell on TDK Super Avilyn—the most expensive of the group in terms of his own buying price.

Since he would be working from masters which had been mixed and monitored for the needs of recording, and since "headroom" would not be likely to be a problem, it was further decided that all Spectro-Frequency cassettes would be recorded Dolby-B. For optimum results therefore, the playback deck should be set for "Dolby On" and "Cr0-2"—the latter being explained by the fact that TDK-SA is normally recorded with the same settings as for chromium dioxide tape.

Where the deck does not have either or both of these provisions, the "Cr0" requirement can be ignored and the "Dolby" characteristic approximated by a small amount of treble cut in the amplifier setting.

The Spectro-Frequency cassettes are individually copied at normal speed on Nakamichi decks, fed with signal from a Revox A77 playing the working master at its correct speed of 15ips.

Four albums were selected for the initial Sprectro-Frequency release—two double albums from the M7 label and two "Parker" single albums.

The double albums are "Apollo 100" and "Rogers, Hammerstein & Hart", the

HOW TO CLEAN CASSETTE HEADS

Just as the stylus of a disc record player has to be kept free of lint or other build-up, so it is necessary to keep clean the heads of tape recorder/players. It is particularly important with compact cassette equipment because of the very narrow tracks and the fact that the heads are tucked away out of sight—and out of mind!

While manufacturers seek to ensure a good bond between the coating and tape base, some rub-off of coating and lubricant does inevitably occur—a minimal amount in the case of the best tapes, considerably more with tapes of more dubious origin. Where a build-up does occur, evident as a brownish coating on the exposed surface of the head, it tends to lift the magnetised coating away from the magnetic gap, reducing output and high frequency response during playback and impairing recording as well.

The amount of build-up tends to vary with the particular deck and the type of tape commonly used with it, but the fact remains that all tape deck owners should be alert to the possibility of head fouling and must expect to encounter it from time to time.

The question which follows, of course, is how to keep the heads clean and this leads naturally to the observation as to how NOT to do it. Heads must NEVER be scraped with a tool nor rubbed with emery cloth or any other workshop or household abrasive. Such treatment may roughen the residue without totally removing it, or it may score the head, or it may cause microscopic chipping. A further danger is that any force applied to the head may upset its quite critical alignment.

Much the preferred method is to dissolve and remove the coating with the aid of a "cotton bud" or equivalent (a small ball of cotton wool on a matchstick) moistened with methylated spirit. If you want to be ultra-fussy, use the pure form obtainable from a chemist. A couple of rubs every now and again will keep the head surfaces completely clean.

Use only methylated spirit or a cleaning expressly provided with a deck for head cleaning. Deck manufacturers are nervous about using other general purpose "electrical" fluids on tape heads, because of the possibility of some of the reacting on materials involved in the head construction.

If the heads are inaccessable, or you are nervous about fiddling with them anyway, a simple alternative is to purchase and use a head cleaning cassette such as the one pictured, put out by TDK. It contains a short length of a specially fabricated tape, carrying just enough cleaning formulation to remove the coating from heads, without damaging them. In fact, the literature claims that periodic use of the Head Cleaner cassette type HC-1 will control build-up on other components such as guides, capstans and rollers.

The head cleaner is loaded with the specified side up and operated in exactly the same way as an ordinary cassette. TDK suggest that it be placed in position and the deck switched into play mode. When the tape stops, rewind and repeat the procedure.

As a guide, they suggest that it be used after about 10 playings of ordinary cassettes, limiting use of the cleaner to about 24 occasions. On this basis, one TDK head cleaner would typically cope with about 200 hours of deck use.

But, even if you decide to rely in some degree on the cotton bud and metho treatment, a head cleaner cassette would obviously be a handy gadget to have around as a quick and easy method of making sure.

Distributors for TDK in Australia are Convoy International Pty Ltd, 4 Dowling St, Woolloomooloo, NSW 2011.

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latter recorded in the Sydney Opera House with Tommy Tycho and his Good Music Orchestra. Double albums like these lend themselves to the Spectro-Frequency concept because they will fit on to the one C90 blank cassette, thereby simplifying production and minimising cost. It is anticipated that each double album cassette will retail for about $11.98.

The two "single album" cassettes are both of music from the Parker label: "Beyond The Blue Horizon" with Reubert Hayes playing the Conn Theatre organ, and "Ray Thornleigh Entertains, Vol 1", another organ record but this time a Lowrey. These tapes will be priced at $7.98 each, as compared with $5.98 for the ordinary high speed cassette and $4.98 for the disc.

Because of their specialised nature and limited release, the Spectro-Frequency cassettes may not be available ex-stock from all suppliers but they can be ordered by record dealers and departments from M7 Records Pty Ltd, at 28 Cross St, Brookvale, NSW.

Another M7 release, Reubert Hayes' very successful "Favourites of the Forces Sing-Song", recorded in the first instance by Parker, is also being made available in the new format cassette. However, it will be available only by mail order direct from Parker Recordings at P.O. Box 134, Toongabbie, NSW 2146. The price is $7.98 plus 50c pack and post (for each cassette) within Australia.

At the time of writing, we have had the opportunity of comparing four of the five special cassettes with their disc counterparts. Each pair was played back on high (but typical) quality disc and tape decks, started simultaneously, fed into the one amplifier and directly compared by switching from one to the other.

With "Rogers, Hammerstein and Hart", there was virtually nothing to choose between cassette and disc.

With "Favourites of the Forces Sing-Song", and "Ray Thornleigh Entertains", opinion marginally favoured the cassette.

With "Beyond The Blue Horizon", the cassette was well ahead of the original disc PRS-008. However, the disc has more recently been recut by Ross Sheard of Sheard & Co Pty Ltd, and simultaneously re-balanced using UREI third-octave graphic equalisers; it now carries the number PKS-008. We marginally preferred this new disc to the cassette because, while the latter was slightly brighter at the top end, the disc had better weight and "roundness" in the middles.

However, in passing such opinions, we are splitting straws. The interesting point is that M7 and Parker have decided to test the market with pre-recorded cassettes that lose nothing by comparison with good discs played on good, flat pickups.

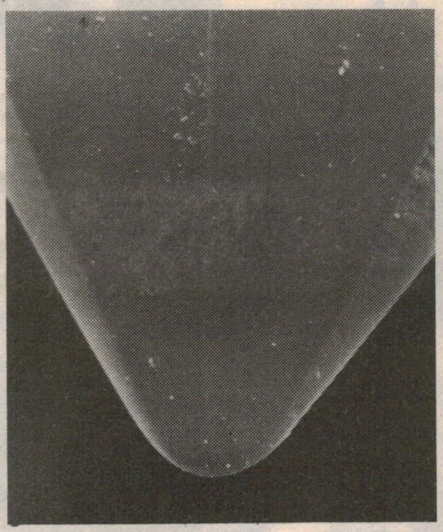
Whether quality enthusiasts will respond is something that the respective backers will have to discover the hard way!

STYLI, CARTRIDGE REPAIRS

A new venture by Messrs Bay Road Electronics, of Cheltenham, Victoria, spells good news for users of magnetic pickup cartridges. The company has set up facilities for the repair and adjustment of cartridges and, as well, specialises in fitting new parabolic diamond styli.

Fortunately, cartridge service and the replacement of worn styli is not a universal problem. In many cases, back-up service is available from the distributors but, there are brands and models where adequate service facilities do not exist or where they are uncertain or expensive.

While it might be too much to hope that a repair facility could cope with any model of cartridge, we gathered from Mr Peter Wright that Bay Road Electronics



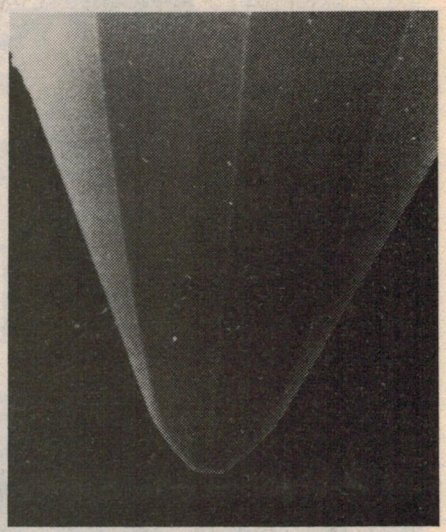
A microphotograph of an elliptical stylus, magnified 1850 times, and taken by the Electron Microscope Unit of the Royal Melbourne Institute of Technology.

are building up stocks of spare parts and, in special cases, they can fabricate such items as stylus cantilevers, etc. Their expertise also extends to moving coil cartridges.

This is only half the story, however. As a vital part of their involvement in cartridge servicing, Bay Road Electronics are specialising in fitting new parabolic diamond styli in the place of original, worn styli or more conventional shape. They claim that they are "grain orientated" and polished to a precision well beyond that of normal production styli. As a result, record wear is minimised, as well as stylus wear.

If a cartridge is in good condition otherwise, with only the original stylus worn, the policy of the company is to remove the original diamond and replace it with a new parabolic type, leaving the cantilever and suspension otherwise untouched.

As for the parabolic shape, it has been brought into prominence by concentrated work on the CD-4 quadraphonic system which makes it desirable to distribute the playing weight vertically up the groove sides, while retaining the ability to track frequencies to well over 40kHz. As a result of this work, it has become possible to produce specially shaped styli to within very close tolerances and at a price which has allowed Bay Electronics to extend the practice into standard non-CD4 stereo cartridges.



A microphotograph of a parabolic stylus also magnified 1850 times. Note the two shoulders, forming an angle of 90 degrees, which sit snugly against the walls of the groove,

As an indication of their service, Bay Road Electronics submitted to us several examples of well known cartridges fitted with the normal manufacturer's styli and their own special parabolic styli. We were invited to make comparisons between them.

Here we were at a disadvantage. While it sounds easy to say: let's check a few cartridges for waveform and trackability at a variety of typical playing weights, the job of actually fitting up each cartridge and performing the tests can become quite time consuming—too much so, in fact, to make possible a statistically adequate sample. We remained in some doubt therefore, as to what extent we were looking at cartridge differences rather than styli differences.

The one thing we can say with certainty, however, is that the refitted cartridges behaved as we would have expected them to do and this would be the vital consideration for any hifi enthusiast faced with a traumatic stylus problem.

(For further information: Bay Road Electronics, 36 Luxmoore St, Cheltenham, Vic 3192. Tel. Melb. 93-1201).

Does your system hunger for one?

Hi fi systems also need the right kind of nourishment. One of the most effective ways of providing it is featured above: the AKAI AA-1020 AM/FM Tuner Amplifier.

It puts out 20 effortless watts RMS per channel (both channels driven, from 20 to 20,000 hz, no more than 0.4% THD into 8 ohms load). It comes with the kind of facilities that produce the best kind of sound. And at $340†, the price isn't likely to turn you off.

But maybe your system hungers for a lot more power, in which case you should see our more powerful models.

Of course, like all AKAI hi fi equipment distributed by AKAI Australia, it comes with our Complete Protection Plan*. Which simply means 12 months full parts and labour warranty on all Tape Equipment, 2 years full parts and labour warranty on all Amplifiers, Turntables and Speakers and a lifetime warranty on all GX Tape Heads.

So, if your amplifier isn't all it should be, see your AKAI dealer. He'll put your mind at ease.

The AKAI Hi-Fi Professionals are: **NEW SOUTH WALES — SYDNEY CITY AND METROPOLITAN. Sydney:** Douglas Hi-Fi, 338 George Street; Duty Free Travellers Supplies, 400 Kent Street; European Electronics, 187 Clarence Street; Instrol Hi Fi, Cnr. Pitt & King Streets; Magnetic Sound Industries, 32 York Street; Jack Stein Audio, 275 Clarence Street. **Bankstown:** Selsound Hi Fi, Cnr. North Terrace & Apian Way. **Burwood:** Electronic Enterprises, 11 Burwood Road; Edge Electrix, 31 Burwood Road. **Concord:** Sonarta Music Services, 24 Cabarita Road. **Cremorne:** Photo Art & Sound, 287 Military Road. **Crows Nest:** Allied Hi Fi, 330 Pacific Highway. **Hurstville:** Hi Fi House, 127 Forest Road. **Liverpool:** Miranda Stereo & Hi Fi Centre, 166 Macquarie Street. **Miranda Fair:** Miranda Hi Fi & Stereo Centre, Shop 67, Top Level. **Mona Vale:** Warringah Hi Fi, Shop 5, Mona Vale Court. **Parramatta:** Gramophone Shop, Shop 151, Westfield Shoppingtown; Selsound Hi Fi, 27 Darcey Street. **Roselands:** Roselands Hi Fi, Gallery Level. **South Hurstville:** Selsound Hi Fi, 803 King George's Road. **Summer Hill:** Fidela Sound Centre, 93B Liverpool Street. **Sutherland:** Sutherland Hi Fi, 5 Boyle Street. **Waitara:** Hornsby Hi Fi, 71 Pacific Highway. **Westleigh:** Sound Incorporated, 16 Westleigh Shopping Centre. **NEW SOUTH WALES COUNTRY. Albury:** Haberecht's Radio & TV, 610 Dean Street. **Bega:** Easdowns, 187-191 Carp Street. **Bowral:** Fred Haves, 293 Bong Bong Street. **Broken Hill:** Pee Jay Sound Centre, 364 Argent Street. **Gosford:** Gosford Hi Fi, 163 Mann Street; Miranda Stereo & Hi Fi Centre, Cnr. Donnison & Baker Streets. **Moss Vale:** Bourne's Merchandising, 1 White Street. **Newcastle:** Ron Chapman Hi Fi, 880 Hunter Street; Eastern Hi Fi, 519 Hunter Street. **Nowra:** Nowra Hi Fi, Shoalhaven Arcade. **Taree:** Taree Photographics, Graphic House, 105 Victoria Street. **Wagga Wagga:** Haberecht's Radio & TV, 128 Baylis Street. **Wollongong:** Hi Fi House, 268 Keira Street; Selsound Hi Fi, 2-6 Crown Lane. **A.C.T. Civic:** Allied Hi Fi, 122 Bunda Street. **Fyshwick:** Allied Hi Fi, 3 Paragon Mall, Gladstone Street. **QUEENSLAND. Brisbane:** Chandler's, 120 Edward Street; Chandler's, 399 Montague Road, West End; Stereo Supplies, 95 Turbot Street; Tel Air Electronics, 187 George Street. **Nambour:** Custom Sound, Currie Street. **Mt. Isa:** The Sound Centre, West Street. **Rockhampton:** Chandler's, 144 Alma Street. **Southport:** Stokes Electronics, Scarborough Street. **SOUTH AUSTRALIA. Adelaide:** Ernsmiths, 48-50 King William Street; Flinders Trading Co., 55 Flinders Street; J B Electronics, 115 Gouger Street. **Blackwood:** Blackwood Sound Centre, 4 Coromandel Parade. **Glenside:** Steiner Electronics, Conyngham Street. **Moana:** Bob Carmen, 185 Commercial Road. **VICTORIA. Melbourne:** Douglas Hi Fi, 191 Bourke Street; **Warrnambool:** A. G. Smith, 159 Liebig Street. **WESTERN AUSTRALIA. Perth:** The Audio Centre, 883 Wellington Street. **Calista:** Hub Hi Fi, Kwinana Hub, Gilmore Avenue. **East Victoria Park:** Japan Hi Fi, 889 Albany Highway. **Nedlands:** Audio Distributors, Broadway Shopping Centre, Broadway. **Midland:** Midland Audio, 16B Great Northern Highway. **Mosman Park:** Audio Distributors, 14 Glyde Street. **W.A. COUNTRY. Bunbury:** Aabel Music, 130 Victoria Street. **Kalgoorlie:** Hambley's Hi Fi, Shop 13, Central Arcade, Hannan Street. **TASMANIA. Burnie:** James Loughran & Sons, 29-31 Wilmot Street. **Hobart:** Quantum Electronics, 181 Collins Street. **Launceston:** Wills & Co., 7 Quadrant. **NORTHERN TERRITORY. Darwin:** Pfitzners Music House, Smith Street.

AKAI

The name you don't have to justify to your friends.

*The Complete Protection Plan does not cover equipment purchased outside Australia. †Recommended retail price only.

70613R

Realistic STA-90 stereo receiver

The "Realistic" brand is available only from Tandy stores. Here we review the Realistic ST-90 AM / FM stereo receiver, which has a conservative power rating of 44 watts RMS per channel. It has comprehensive control facilities and conforms to Australian electrical safety standards.

Some high fidelity enthusiasts may have the impression, mistaken though it is, that "Realistic" is an economy line with all the compromises in quality which often seem to accompany an economy price. This review will clearly demonstrate that the Realistic STA-90 is a high performer which more than favourably compares with its many Japanese competitors.

In fact the Realistic STA-90 is manufactured in Japan to the American design, using the same high quality components as used in most well-known Japanese receivers.

Styling of the STA-90 follows conventional lines with an extruded aluminium control panel with "scratch-grain" finish, matching knobs and "blackout" dial. Overall dimensions are 485 x 147 x 360 (W x H x D) including knobs, rubber feet and rear terminals. The swing-down AM rod antenna requires an extra 50mm of clearance at the rear. Mass is approximately 12kg.

Control facilities on the front panel are again fairly conventional, with the exception of some minor features which set the receiver apart from its competitors. Two sets of loudspeakers can be controlled by the Loudspeaker selector which provides functions: Off, A, B, A + B and Q VOX. The last setting is an abbreviation for Quatravox which is Realistic's term for the "synthetic quad" mode obtained by connecting the rear loudspeakers in series across the stereo output sockets.

When either the AM or FM tuner is in use the dial lights up together with the tuning meters. An unusual stereo beacon is employed. Instead of having a stereo beacon light on the dial, the dial pointer changes colour from white to red when a stereo FM station is being received.

Two meters are provided to facilitate tuning. They have no calibrations but they still perform useful signal indication.

Two jack sockets are provided for a pair of stereo headphones and "Dub Out". The latter refers to a signal output for convenient connection to a tape recorder. This would normally be connected to the "Line Input" sockets of a tape recorder in the same way as would the two pairs of "Tape Rec" outputs on the rear of the receiver.

Five positions are provided on the Input Selector: Auxiliary, Phono, AM, FM and FM Mute. The last-named gives muting of interstation noise when tuning. An interesting feature of the Selector is that its rotary knob controls a large multi-contact slide switch.

An interesting feature of the rear panel is the clamp for the mains cord which provides capacitive coupling into one of the 300 ohm FM antenna terminals. This rudimentary antenna can be satisfactory in strong signal areas, but those not so well served will have to make their own folded dipole with 300 ohm ribbon or resort to a more elaborate roof-mounting antenna.

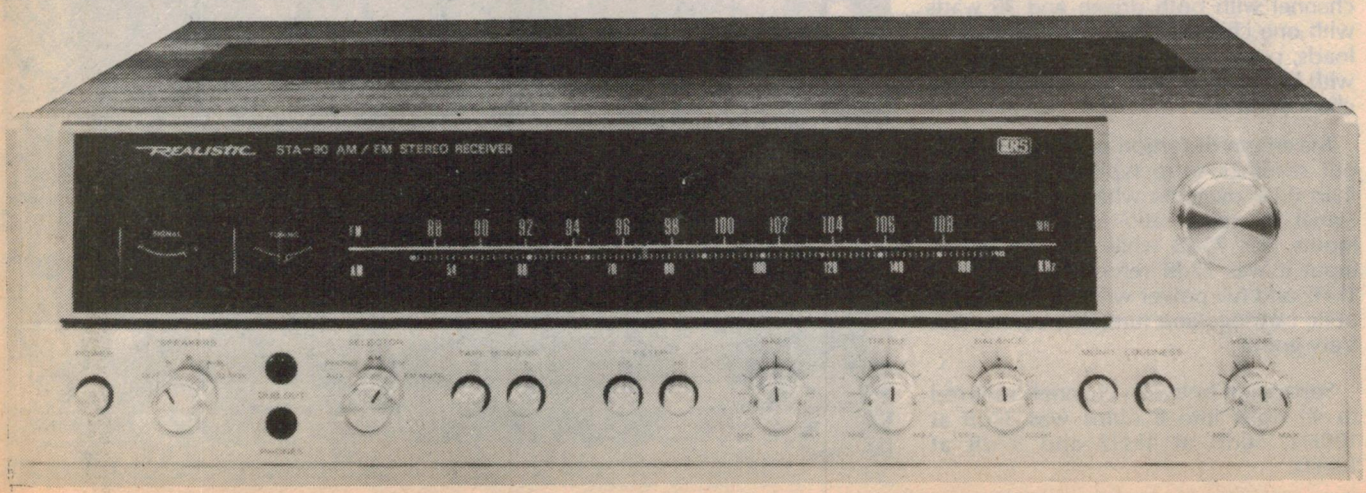
Two 2-pin AC outlets are provided on the rear panel and Tandy have taped them over with warning labels noting that they are 240VAC not 120VAC.

Removing the timber wrap-over cover of the STA-90 reveals the large chassis. The PC board at the rear accommodates the AM and FM tuners while the much larger PC board at the front accommodates the preamplifiers and power amplifiers. A large black-anodised aluminium extrusion provides generous heatsinking for the four power transistors.

Circuitry of the STA-90 is fairly conventional, with discrete transistors used throughout the preamplifiers and power amplifiers while a mixture of integrated circuits and transistors is used in the tuners.

The power amplifiers have balanced positive and negative supply rails and direct coupling to the output by dint of the differential input stages. The output stages operate in quasi-complementary mode. Two small-signal transistors monitor the current in the output stages and remove the input signal from the driver stages if the output is short-circuited or otherwise overloaded.

Complementing this short-term overload protection system is a thermal cutout which interrupts the AC mains if the main heatsink temperature becomes excessive. As well, there is a fuse in the primary circuit of the power transformer.



We would also like to see fuses installed in the positive and negative supply lines to the power amplifiers. These would blow in the case of internal damage to the amplifier, and thus help prevent possible damage to the loudspeakers. Alternatively or in addition, a separate loudspeaker protection circuit could be installed. This general comment applies to any receiver or amplifier with direct-coupled outputs. Replacement loudspeakers can be very expensive!

Performance specifications of the STA-50 as shown in the owner's manual is brief and apparently conservative. Power output is quoted at 44 watts RMS per channel into 8 ohm loads over the range 20Hz to 20kHz, and at less than 0.5% harmonic distortion. This spec was confirmed with plenty to spare.

We measured maximum power output at 53 watts per channel into 8 ohm loads with both channels driven. With one channel, the result was 62 watts. With 4 ohm loads, the result was 30 watts per channel with both driven and 36 watts with one channel driven. With 16 ohms loads, power was 36 watts per channel with both driven and 39 watts with one channel driven.

Maximum distortion reading was 0.2% but readings were typically much less than 0.1% over the whole audio range. Signal to noise ratio for the auxiliary inputs was 75dB while for the phono input it was 72dB referred to 10mV at 1kHz and full power with a typical magnetic cartridge and turntable connected. Very good!

Separation between channels referred to 40 watts into 8 ohms was 37dB at 100Hz, 50dB at 1kHz and 37dB at 10kHz.

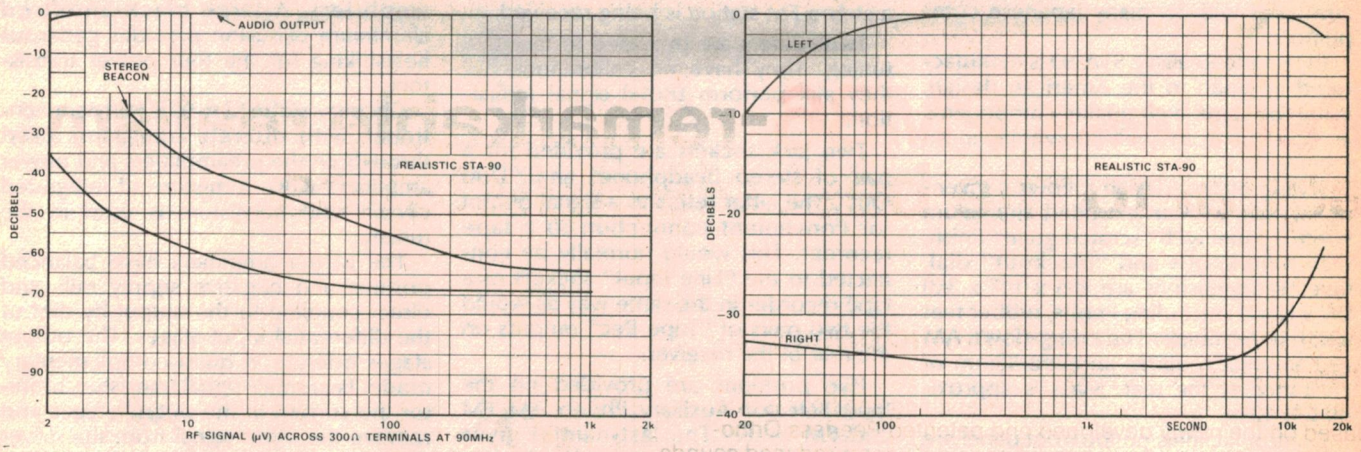
Phono sensitivity is 3mV for 40 watts while overload capability at 1kHz is more than adequate at 150mV. RIAA equalisation is within 1dB over the range 100Hz to 15kHz with a slight boost at 50Hz and rolloff below 30Hz. Frequency response of the preamplifiers and power amplifier is 1dB down at 20Hz and 20kHz. Square wave response was good, and stability with capacitances shunting the load was satisfactory. There was a slight anomaly in the response when the load was shunted with a 2uF capacitor. This produced a boost of 7dB at 30kHz.

We can sum up the FM tuner performance as excellent and likely to be bettered by few receivers, regardless of price. This applies particularly to the Quieting curves. Total harmonic distortion for mono reception was 0.2% at 100Hz, 0.1% at 1kHz and 0.5% at 6kHz. In stereo, THD results were 0.4% at 100Hz and 1kHz and 1.2% at 6kHz. 19kHz residual was 47db with respect to 100% modulation.

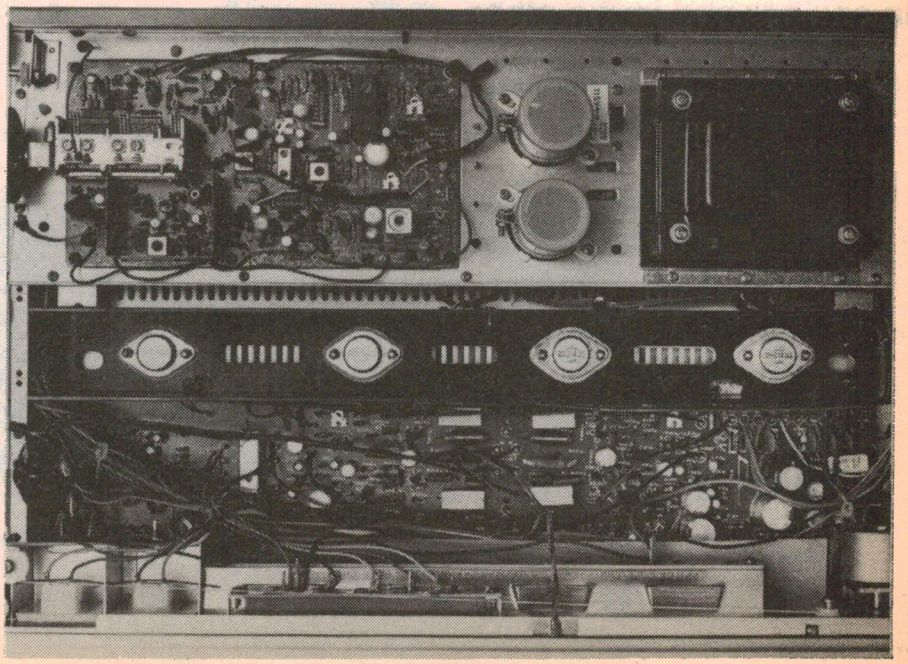
AM tuner performance is typically poor, as we have come to expect from most stereo receivers. Never mind . . .

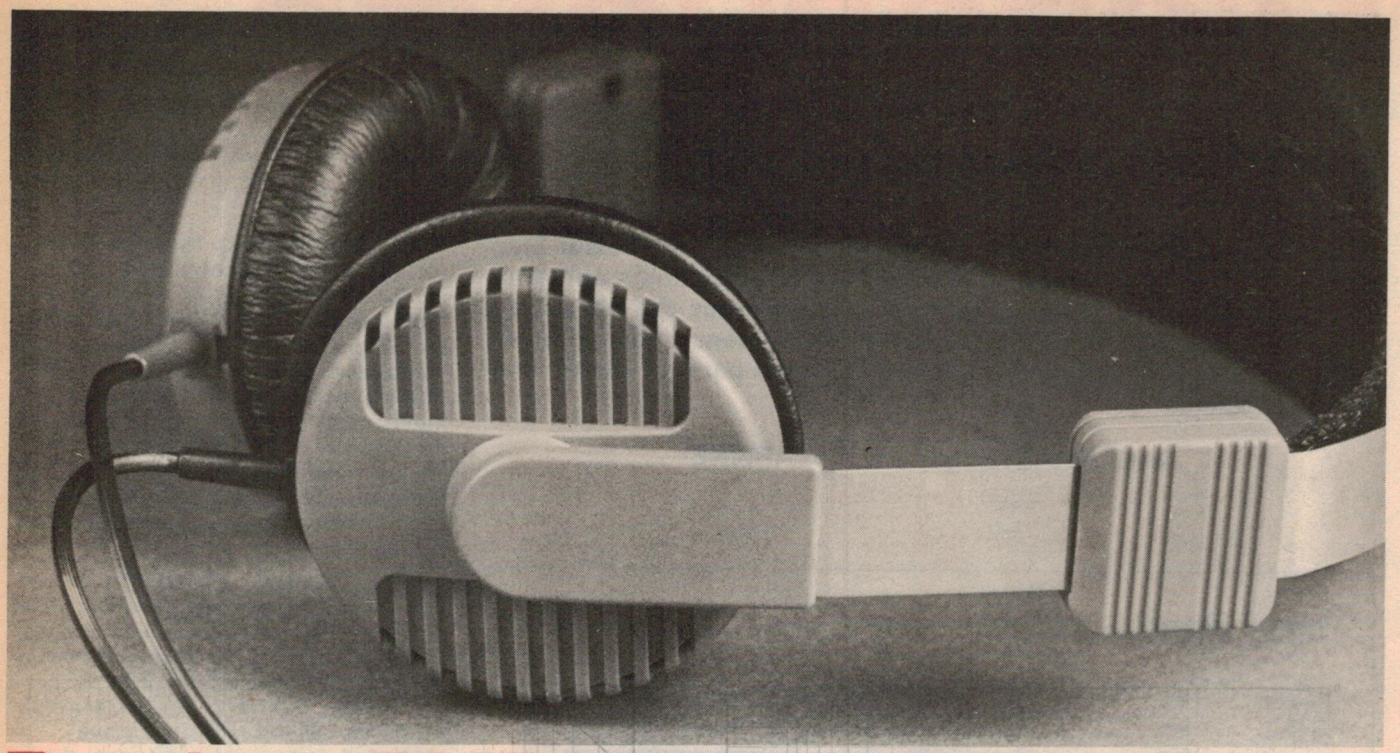
We found the STA-90 easy to use with its uncomplicated control layout. All controls operate smoothly and progressively, and the unit is quiet when no signals are present. Nor is electrical interference a problem.

In short, high marks can be awarded for the performance of the STA-90 by Realistic. It is a well made product with the advantage of a large distributor network and extensive servicing facilities. Recommended retail price of the STA-90 is $399.95. Discounts are available if purchased in a package deal. Realistic audio products are available from Tandy stores throughout Australia. (L.D.S.)



Above are the excellent Quieting characteristics plus the frequency response and separation between channels of the STA-90 FM tuner circuitry.





Peerless PMB6-remarkable realism equal to the best electrostatics

New Peerless Orthodynamic principle– this is really living

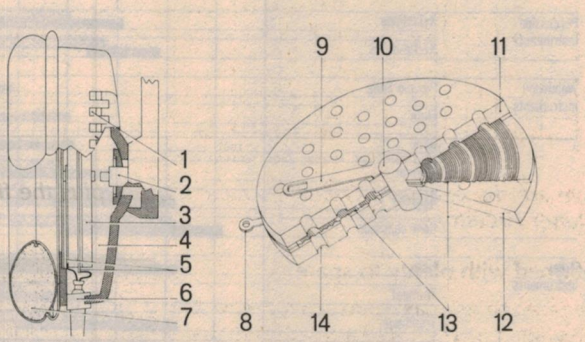
With Peerless PMB6 headphones everything you hear is true. Based on the newly developed and patented Peerless Orthodynamic principle, PMB6 headphones deliver reproduced sounds equal in quality to the most sophisticated electrostatics. Peerless bring it back alive–sounds so real, you feel you're actually there.

In one ear and in the other– in total comfort

There's nothing more annoying than headphones that clamp you in a head-lock.
With Peerless featherweight construction, fine fit and pillow-soft ear pads, absolute comfort is certain over long time listening.

Until you've heard it through Peerless– you just haven't heard it!

Between two perforated ferrite magnet discs lies an ultra thin diaphragm/voice coil. This light and very elastic diaphragm, whose total surface is put into motion, makes crystal clear high frequency reproduction possible. Its construction also ensures uniform phase characteristics and low distortion. The diagram below details this novel new design.
In your favourite piece of recorded music, you'll hear notes and nuances you'd never have believed existed.



1. Air holes. 2. Ball joint suspension. 3. Drive unit. 4. Damping material. 5. Terminals. 6. Cable grip. 7. Ear pads. 8. Terminal. 9. Terminal. 10. Centre axle. 11. Magnet. 12. Magnet. 13. Diaphragm/voice coil. 14. Hole in magnet.

Peerless PMB6 Technical Data

Frequency:	Range 16-20,000 Hz
Impedance:	140 Ohms
Max. Constant Load:	40 dB
Operating Power:	2.5 mW
Distortion:	1%
Rated Input:	2W (DIN)
Weight:	210 g
Colours:	Black, Red and Olive Green

Peerless PMB6 $49

Electrostatic quality, superb comfort and a realistic price

Peerless

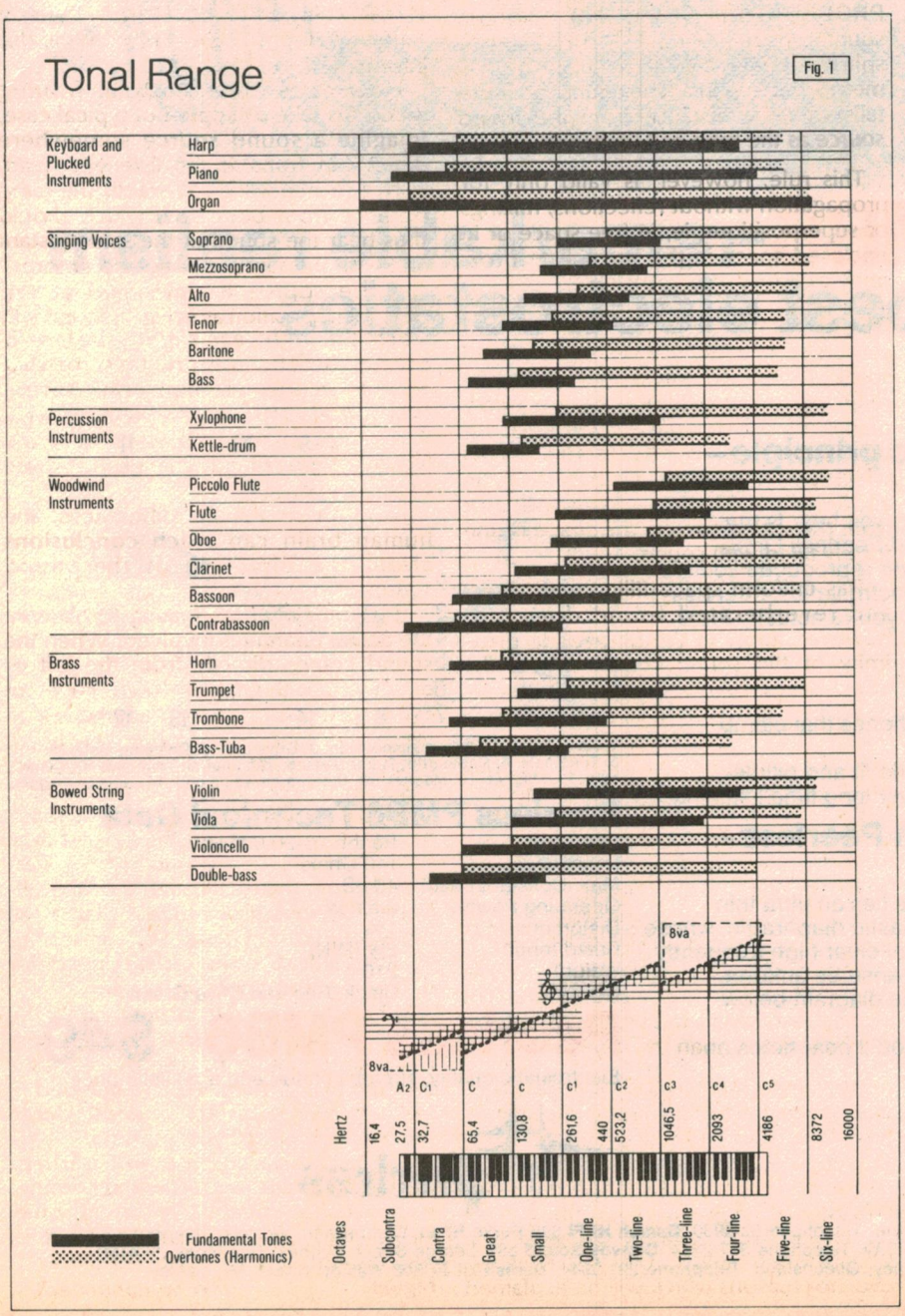
Danish Hi Fi Shop 9, Southern Cross Hotel, Melbourne. Telephone 63 8930. **Danish Hi Fi** 698 Burke Road, Camberwell, Victoria. Telephone 82 4839. **Convoy Sound** 1 Maclean Street, Woolloomooloo, N.S.W. Telephone 357 2444. **Convoy Sound** 387 George Street, Sydney. Telephone 29 4466. **Brisbane Agencies** 72 Wickham Street, Fortitude Valley, Queensland. Telephone 221 9944. **Danish Hi Fi** 308 Walcott Street, Mt. Lawley, Western Australia. Telephone 71 0100.

MICROPHONES

Part 1: Basics of sound and hearing

This series of articles, reproduced by courtesy of Sennheiser Electronic, is especially intended to assist sub-professionals and amateurs who need to use microphones, but without the advantage of formal acoustic training. This first part is concerned primarily with the nature of sound itself, and is directed particularly to amateur recordists.

by G. PRAETZEL and E. F. WARNKE*



NATURE OF SOUND: "Sound is a wave movement which takes place in acoustic media". For our purposes we can convert this definition into "Sound is a wave movement of the air, audible to the human ear". By restricting it to the "wave movement of the air" we disregard mechanical vibration, i.e., the sound propagation in solid bodies; by restricting it to "audible to the human ear", we disregard the "infrasound" below and the "ultrasound" above the threshold of human hearing.

PITCH, OCTAVE, FREQUENCY: The human ear, as a sensing organ has some rather special properties. For instance, musical tones whose fundamental frequencies are in the ratio of 2:1 are perceived as being closely related. Musicians call this ratio an "octave".

Musical instruments, between them, cover a range of about 10 octaves, from the subcontra octave (16.4Hz) to the six-line octave (16000Hz). The letters Hz are short for "Hertz" which is the modern abbreviation for vibrations per second or, more familiarly, cycles per second. All these terms relate to what we call "frequency".

The vibrating parts of musical instruments—strings, bars of wood or metal, stretched diaphragms, or air columns—generate overtones or harmonics in addition to their fundamental tone. These higher frequency "overtones", or "harmonics", or "partials", impart an extra brilliance, or edginess, or "colour" to the sound, which gives it a particular quality or "timbre". It is important, therefore, that they be not lost during recording or reproduction, or changed significantly in strength.

A still further point, well illustrated by a piano, is that the sound composition of a note can change between the moment it is struck and when it dies away to inaudibility. This "transient" quality is also vital in discerning and preserving the nature of an instrumental sound.

Frequencies corresponding to very low tones (in the subcontra octave, ie, below about 32Hz) are rarely called for by composers or played by musicians, nor can they be readily reproduced by loudspeakers in living rooms.

The spectrum, ie, the range between the lowest and the highest tone to be heard, stored, transmitted or reproduced is commonly called the "bandwidth" and is also specified in Hz.

*Reproduced by arrangement with Sennheiser Electronic. Translated by T. M. Jaskolski and adapted for magazine publication by W. N. Williams.

AUDIBLE FREQUENCIES: According to experts in the subject, the human ear starts to age from babyhood, a 3-month old child being able to perceive frequencies between 20 and 20,000Hz. However, the upper limit of hearing falls by about 2000Hz for each decade of life. A 10-year-old hears up to about 18,000Hz, a 20-year-old to about 16,000Hz, a thirty-year-old to about 14,000Hz, a 40-year-old to 12,000 Hz, a 50-year-old to 10,000, and a 60-year-old to about 8,000Hz.

Fig. 1 shows how important the range of the human ear is for full perception of sound, by illustrating important musical instruments and human voices, with their respective fundamental tones and overtone ranges. While the fundamental tones determine the perceived tone pitch, the overtones and "formants" determine the typical sound colour (timbre) of a particular instrument or an individual human voice. Formants arise from resonance formation in sound sources and are marked by frequency ranges of increased intensity.

The falling perception of higher tones with growing age leads to the fact that older people do not discriminate overtones, characterizing individual instruments, with such clearness as do younger people.

DYNAMIC RANGE: Considered musically, "dynamic range" refers to the different loudness levels in a musical interpretation, e.g., the span of volume between fortissimo and pianissimo. When recording a live sound performance with microphones, every effort must be made to transfer the true dynamic range. Technical risk includes increased distortion during transmission of very high levels, while very low levels may disappear in hum and noise. For this reason the dynamic range for a recording—especially in classical works—must be reduced somewhat in almost all cases.

Any such reduction of the original dynamics in the transmission or recording of a musical composition requires considerable empathy, on the part of the recording engineer, with the score of the composition concerned.

Well before an approaching pianissimo, which might otherwise be lost in the noise of the system, the gain of the microphone channel(s) will be slowly and carefully increased, then lowered back to normal for what follows.

By contrast, anticipating an approaching fortissimo, which may overload the system and produce distortion, the microphone gain may be slowly eased back to keep the peak level within manageable limits.

Needless to say, musical compositions with a lower dynamic range present much less of a problem. Mainly, one has only to ensure that the loudest passage, while approaching the limits of the system, does not cause actual overload. This can usually be established during setting-up and rehearsal.

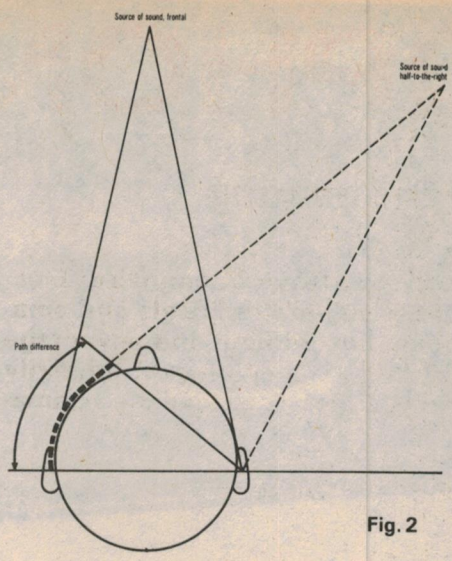


Fig. 2

PROPAGATION OF SOUND: Airborne sound propagates from the sound source spherically with a velocity of approx. 330 metres per second. The sound pressure falls with the distance from the sound source as the ratio of 1/distance.

This rule, however, is valid only for propagation without reflections, mixings or superpositions, ie, in free space or in enclosed space in the immediate proximity of the source of sound.

REVERBERATION: When a sound source is placed thus in an enclosed space, the sound waves are repeatedly reflected to and fro by the boundary planes. After a short time, a complete intermixing takes place of sound waves which penetrate each other mutually in all directions. Thus, at greater distance from the sound source, the space is uniformly filled with sound.

This uniform space filling with direct and reverberated sound does not, however, apply to the immediate proximity of the sound source. Here, the direct sound from the source prevails over those sound waves which are reflected by the walls. A microphone placed in proximity of the source thus reacts more to the direct sound and less to the room reverberation; to change the ratio between direct sound and reverberation, the source-to-microphone distance has to be varied.

The distance where the direct sound and the reverberation are in balance is called in German "Hallradius". Within this radius the direct sound prevails while, beyond this radius, the reverberation is stronger than the direct sound.

How large this "radius" is depends to a great extent upon the reflecting properties of the walls, the ceiling and the floor, as well as the furnishing and the size of room concerned. It is obvious that strongly reflecting walls, ceilings and floors and hard furniture, as well as a small room dictate a short radius. However, for reasons which will be explained in a later article, we cannot place our microphone (or microphones) very near to a large sound source; therefore a larger and more attenuated room is preferable for microphone recordings than a small and undamped room.

In short, reverberation time is a property of the recording room, and it determines critically, the quality of a sound recording. It is defined as the time which elapses until a sound event dies away to the millionth part of its energy, or to -60dB relative to its maximum sound pressure.

The optimum reverberation time varies for particular types of music. In general, it can be said that reverberation times not exceeding 1.5 seconds are optimum for recordings of classical and modern music. Rooms for pop—or jazz music—should have a reverberation time below 0.8 second.

STEREOPHONIC HEARING: Pairs of human sensing organs provide spatial information.

How does human spatial hearing work? To take a simple but typical case, imagine a sound source somewhere directly in front of the listener's head. Such a source will be at exactly the same distance from both ears, which should thus hear the sound at the same instant and with the same volume and timbre.

If the source is envisaged at the right/front position as in Fig. 2, sound will reach the right ear slightly before it reaches the left. It will also be somewhat weaker in the left ear, after having travelled around the head and, as well, differences in the behaviour of some overtones may slightly change the timbre of the sound.

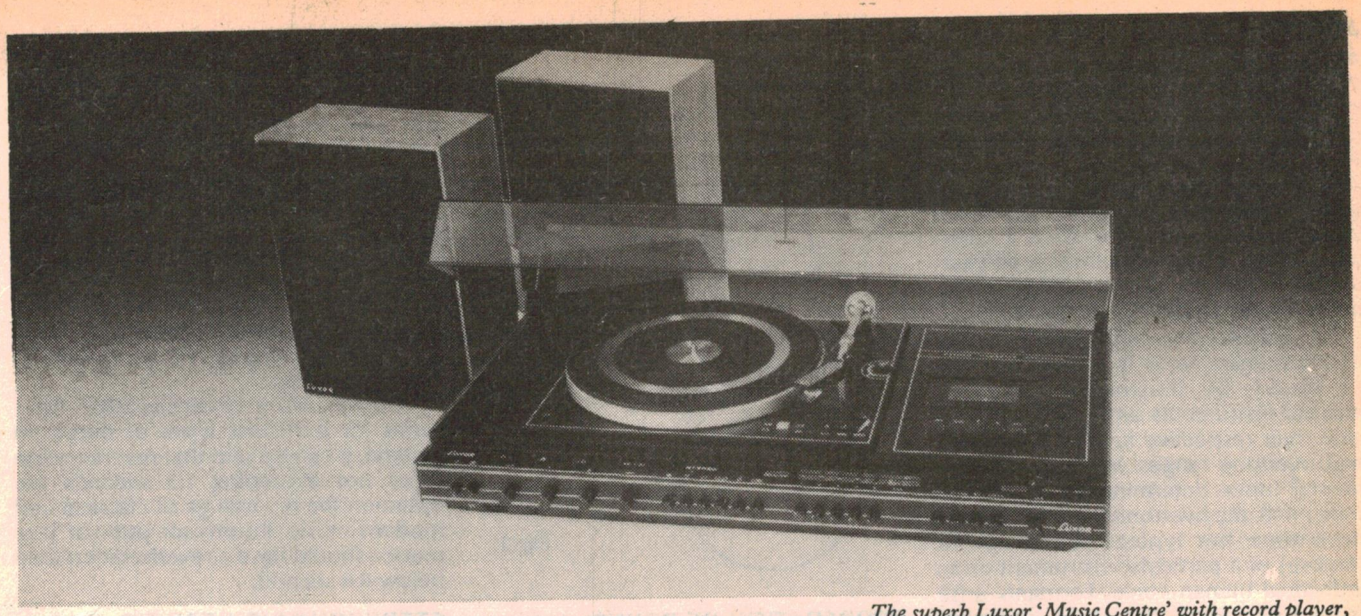
From these minute differences, the human brain can reach conclusions about the direction of the sound source.

It is somewhat fascinating to observe the actual quantities involved: When the sound comes directly from the left or directly from the right, it has to cover an extra path of 13 to 16 centimetres to reach the other ear around the head. Sound travels 330 metres in one second. Thus less than one thousandth of a second is required by the sound to reach the other ear and this is the longest time delay. In cases of a sound coming only slightly from the right or left the time difference shrinks down to less than a ten thousandth of a second. Yet our hearing centre is still able to evaluate time delay differences of such a low order.

What is more, the facility cannot be switched off. We hear everything spatially, street traffic noises as well, as a symphony orchestra. To be reminded of the differences, select a good stereo record, then switch it to mono!

Having done so, you will perhaps decide to make your own recordings exclusively in stereo. It is better, often easier, although the cost in terms of microphones and tape recorder is higher.

(To be continued)



The superb Luxor 'Music Centre' with record player, cassette deck, AM/FM radio.

Introducing the Luxor 'Swedish Sound'

Sweden's largest-selling range of high quality stereo systems is here to spread its superb sound around Australia

In 1923 at Motala in Sweden, Luxor first began mass production of radio sets. Today, Luxor are Sweden's largest selling, high quality stereo systems.

Record players of precision and reliability. Luxor features include a magnetic dynamic cartridge with adjustable stylus pressure. And a 16-pole synchronous motor and belt-drive for low wow and flutter.

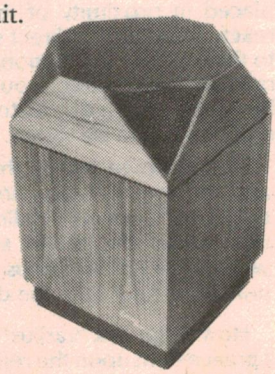
The popular Luxor Record Player

Amplifiers with the quality of 'Ambiophonic sound'. Luxor have developed a 4-channel stereo system, called 'Ambiophonic sound', as a feature of the larger amplifiers. Other features include easily-operated slide controls, and switches for automatic frequency control, AM/FM radio, tape recorder, record player, headphones and loudness compensation.

Cassette decks for fast, smooth operation. With a Dynamic Noise Limiter or Dolby noise suppression. Automatic switching for chrome dioxide tapes. And, 90 second fast-forward and rewind on C-60 tapes.

The Luxor Cassette with Dolby noise suppression.

Speakers to suit all systems. From the Omni-directional Luxor loudspeaker with a 20 cm bass unit and four 5 cm treble units. To the 15 W speaker with a 13 cm drive unit and 6.5 cm treble unit.



The Omni-directional loudspeaker for floor standing adjacent to wall.

They look as good as they sound. Luxor stereo systems combine a careful attention to detail with an unmistakable touch of design flair. Elegant and sleek. In superb cabinets of walnut, teak and rosewood. And black or white lacquer.

The superb Swedish sound. As Sweden has developed in the world of music, so Luxor has developed in reproducing that sound.

The more you know about Luxor stereo systems, the more impressive they become.

The need for distributors and stockists to spread the sound. Distributors are required in Queensland, South and Western Australia and Tasmania. And stockists are required in all States. See the coupon below.

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of Sweden

To: Luxor, P.O. Box 307, Collingwood, Victoria, 3066
I am interested in becoming a Luxor stockist and would like to know about the Luxor range of products.

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(Luxor, c/- 77 Wellington Street, Collingwood, 3066)

LUX 148

B&W DM5 Loudspeaker

The B&W DM5 is a compact two-way loudspeaker system employing the same tweeter as the highly rated DM6 system. Frequency response is within 5dB over the range from 80Hz to 20kHz. They are sold in matched pairs and each system is supplied with an individual frequency response curve.

In contrast with the larger B&W DM2 and DM6 loudspeakers, the DM5 is quite conventional in appearance. It has a well finished cabinet in veneered particle board and has a black acoustic-foam front which can be peeled off for a look at the loudspeakers. Dimensions are 226 x 455 x 257mm (W x H x D) including the foam front.

While the black foam front certainly appears to be acoustically transparent and non-resonant, we gained the impression that it was too easy to remove. It could be a particular temptation for young children with curious fingers.

In fact, we sometimes wonder why grille assemblies are being made so easily removable. It may serve to display a set of impressive-looking drivers but that is no indication that the system will produce a high quality sound.

Be that as it may the tweeter in the DM5 is recognisably the same as that used in the DM6 reviewed in these pages in August 1976. It has woven polyester dome approximately 20mm in diameter. The woofer appears to be similar if not identical with the midrange unit of the DM6. It has a woven synthetic fibre cone with a roll surround.

Also occupying the front panel is a heavy gauge metal plate which is screen printed with a typical frequency response plot of the DM5. This is actually the mounting panel for the crossover network PC board. The board is quite thick at about 2.5mm and accommodates two inductors and four metallised polyester capacitors.

Protection against overdrive or possible catastrophic amplifier faults is provided by a 2 amp fuse. This is a worthwhile feature for any good loudspeaker system. It will result in a small degradation in system damping factor and perhaps also a small increase in distortion due to the non-linear resistance of fuse wire, but the nett effect would probably be insignificant.

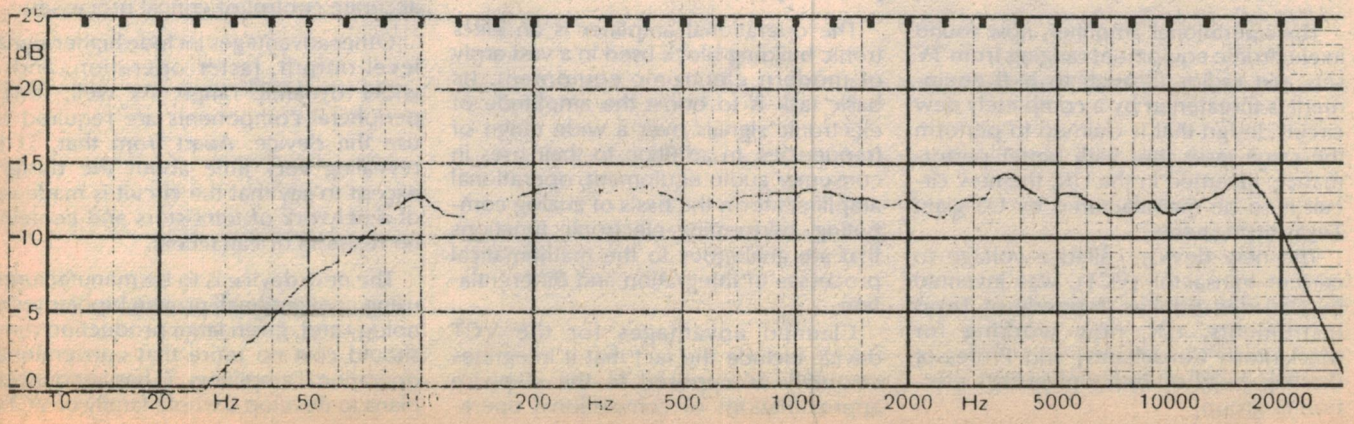
The impedance curve shows a well damped woofer resonance at 70Hz and another peak at 2.5kHz presumably indicates the crossover frequency. Minimum impedance occurs at about 180Hz and 18kHz. At these points the impedance dips to 5 ohms which may be a little low for some amplifiers.

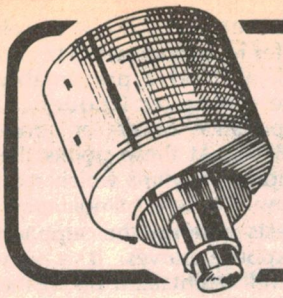
Listening tests confirm the supplied frequency response curves. It is very smooth and well maintained up to the limit of audibility. Bass is not emphasised but is still quite strong to below 50Hz. Modest bass boost can be applied without doubling occurring. Overall system balance is very good.

Superb results can be obtained on almost all types of music, although pipe organ enthusiasts will doubtless find the system wanting in the lowest octave. Overall, the DM5 can be rated as a compact system of very high quality. Over most of the audio range it gives results comparable with many systems of much higher price.

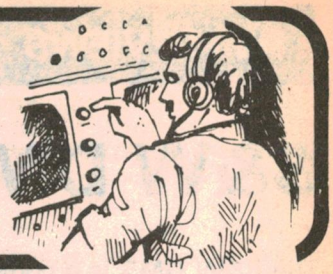
Further information and demonstrations can be obtained from high fidelity retailers or from the Australian distributors for B&W, Convoy International Pty Ltd, 4 Dowling Street Woolloomooloo, NSW 2011. (L.D.S.)

The black foam front of the DM5 peels off to reveal the two loudspeakers on the baffle. Below is one of the individual frequency response plots supplied with our sample pair of DM5's.





News Highlights



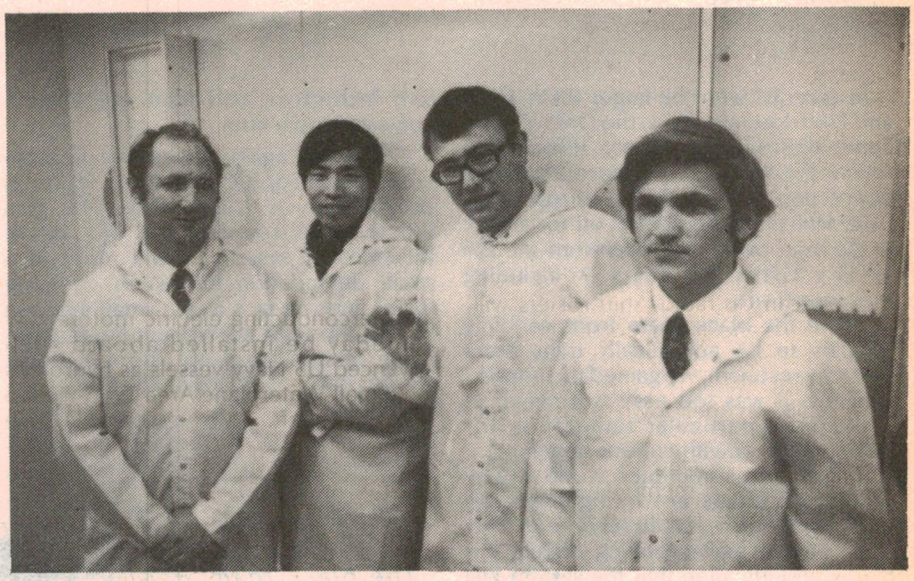
University research team makes practical transistor

Although the theoretical aspects of semiconductor operation have been well known for years, design and fabrication techniques of practical devices are not so well known. Device fabrication has been confined almost exclusively to large electronics companies which, not surprisingly, are unwilling to divulge detailed information of manufacturing techniques.

Anyone starting out from scratch therefore has to learn the hard way, and a research team at the University of NSW has done just that. Working in the University's Department of Solid-State Electronics, the team recently succeeded in designing and manufacturing a practical, working transistor.

The transistor, a MOSFET device, was designed by Dr Peter Ladbrooke and PhD student Star Huang following 6 years of effort by the team as a whole to establish a laboratory for semiconductor device research and manufacture. The laboratory and much of its equipment was designed and constructed by Dr Richard Vaughan, Professional Officer Dr Peter Kosel, Research Student Michael Strudwick, and Technical Officer Brian Varley.

One of the main problems facing the research team was the development of clean room facilities. There are, according to Dr Vaughan, approximately 10 million particles of dust per cubic foot in ordinary air. The clean room facilities reduce this figure to 1 or 2 per cubic foot.



Pictured in the "clean room" where the transistor was made are (left to right) Dr Richard Vaughan, Mr Star Huang, Dr Peter Ladbrooke and Dr Peter Kosel.

Very precise furnace temperatures are also required during the manufacturing process. The furnace at the University of NSW is capable of regulating the temperature to within ¼°C at 1000°C.

MOSFETs are regarded as the most difficult transistors to make, and the type developed at the university takes some 72 man-hours to process. According to Dr Ladbrooke, "it is comparable with commercial devices currently available from semiconductor device manufacturers and uses the same technology as the MOS integrated circuits found in everything from pocket calculators to spacecraft."

Now that the technology hurdle has been overcome, the aim is to produce a range of original transistor and integrated circuit designs. In particular, the team hopes to concentrate on very high frequency FETs and integrated circuits for medical equipment, as well as developing specialised ICs in support of university research projects.

A replacement for the op amp?

The operational amplifier, now found in electronic equipment ranging from TV sets and radios through to hi-fi equipment is threatened by a completely new circuit design that is claimed to perform the same tasks, but with better performance. Invented in the UK, the new circuit is to be manufactured by US giant Texas Instruments.

The new device, called a voltage to current transactor (VCT), was invented by Carl den Brinker (formerly of Texas Instruments, UK, now working for Mackintosh Consultants) and Professor Gosling, head of Bath University's electronics group.

The operational amplifier is an electronic building block used in a vast array of modern electronic equipment. Its basic task is to boost the amplitude of electronic signals over a wide range of frequencies. In addition to their uses in consumer audio equipment, operational amplifiers form the basis of analog computing, performing electronic functions that are analogous to the mathematical processes of integration and differentiation.

Claimed advantages for the VCT device include the fact that it integrates smoothly as opposed to the stepwise approximations of conventional operational amplifiers. This will make for more accurate control of critical processes.

Other advantages include higher signal level output, faster operation, and a wider dynamic range. As well, fewer peripheral components are required to use the device. Apart from that, TI is revealing very little about the design, except to say that the circuit is made up of a network of transistors and contains no resistors or capacitors.

The new device is to be manufactured using conventional, proven bipolar technology and, given large production runs, should cost no more that conventional operational amplifiers. TI has announced plans to develop a whole family of VCTs.

The push is on for CB radio

A non-clandestine organisation calling itself the National Citizens' Radio Association (NCRA) was recently formed in Sydney with the aim of lobbying the Government to legalise CB radio. The organisation, formed by Sydney advertising executive Mr Bill Payne, has already had significant talks with government representatives and an inquiry is now under way.

The NCRA emphasises that it is not a "pirate" organisation. It sees itself primarily as a pressure group in the campaign for legalised 27MHz CB radio, and is asking for volunteers to help in the campaign.

Volunteers are also required to man the NCRA's Citizens' Radio Emergency Service Team (CREST) which will involve monitoring Channel 9 (27.065MHz) of the 27MHz band. This channel has been set aside by the CREST as an emergency channel and is the same as the one used on American CB radio. Shift rosters will be involved, and the ultimate aim is to provide a 24 hour monitoring service.

Members of CREST will relay emergency calls on their own transceivers, usually from cars. Typical emergency situations would include road accidents and bushfires, and members will be on the alert for these, particularly in remote locations. Technically, though, these people will be breaking the law since their CB equipment is not licensed.

The purpose of the monitoring service is two-fold: (1) to render assistance to any emergency calls by advising the appropriate authorities; and (2) to demonstrate the usefulness of CB radio to the authorities. Those readers interested in helping the CREST should write, nominating the hours they can monitor, to The National Director, National Citizens' Radio Association, Box M101, Sydney Mail Exchange, NSW 2012.

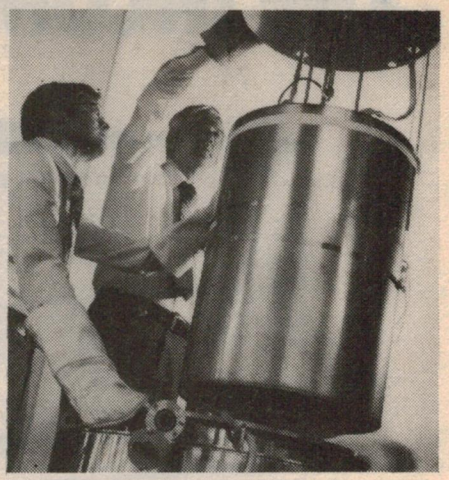
Low-cost microfilmer

The Kodak Oracle Microfilmer is one of four products in a new family designed for rapid filming of documents. Up to eight 11 x 14in documents per minute can be filmed and encoded.

Supercold motors will power US Navy

Supercold electric motors, chilled 450°F below zero, may power high-speed US Navy ships on antisubmarine, oceanic-research, and cargo-carrying missions of the 1980s.

Two 3,000-horsepower superconducting electric motors—the forerunners of the 20,000-to-40,000-horsepower supercold units of the future—are being designed at the General Electric Research and Development Center and constructed by the company's Large Motor and Generator Department, both in Schenectady, NY, under a $US4.57 million contract with the US Naval Sea Systems Command. The first motor is scheduled for sea trials beginning in late 1977.



At the heart of each motor is a 350-pound magnetic coil shown here emerging from a liquid helium dewar following tests at Intermagnetics General Corporation's plant in nearby Guilderland, NY.

Superconducting electric motors may someday be installed aboard such advanced US Navy vessels as hydrofoils and Small Waterplane Area Twin-Hulled (SWATH) craft. Both vessels ride high out of the water—a hydrofoil on underwater steel "wings", and a SWATH craft on submerged tubular hulls. The SWATH design provides a relatively smooth ride even in heavy seas, while the hydrofoil is capable of high-speed maneuvering.

In early designs of these super-fast ships, power from a deck-level turbine was transmitted to the propeller by means of a right-angle drive shaft. In a superconducting system, the turbine would drive a super-cooled generator, which would provide the electricity to power GE's motors.

This means that the mechanical transmission would be replaced by alignment-free electric cable running from the generator to the motor, which would power the propellers. Since the propellers would spin independently of the turbine, the latter always could be operated at optimum speeds for minimum fuel consumption.

Data terminal responds to voice commands

Widespread use of spoken words as a means of communication with computers has been forecast by the EMI group following the introduction by its subsidiary, EMI Threshold Limited, of a low-cost data terminal which is operated solely by the human voice.

Designated the Threshold 500, this advanced simple-to-operate data entry station is designed to replace or complement conventional intelligent video display units or keyboard terminals, both in minicomputer applications and large multi-terminal data processing installations. A range of standard output interfaces makes the equipment plug-compatible with virtually every data processing system.

The Threshold 500 terminal is ideal for increasing job efficiency in situations where manually-operated data entry techniques cannot be applied because an operator's hands and, perhaps, eyes are already fully occupied. It overcomes the limitations of conventional computer communication methods especially in eliminating the intermediate paperwork associated with data preparation.

Basically, the unit comprises a speech processor unit, an alpha-numeric display, and a microphone headset. It is able to recognise words spoken in any language —from Japanese to Punjabi—irrespective of vocabulary, accent, dialect or speech impediment, and even against the background sounds of an operational environment. The standard 500 machine has a minimum vocabulary of 32 words or short phrases, which can be expanded as required.

Users of the Threshold 500 terminal 'train' the equipment to understand their individual pronunciation of the vocabulary by repeating each word either 5 or 10 times into a noise-cancelling microphone. The repetition of each word enables the 500 terminal to obtain an average voice pattern from the slight variations which occur each time the speaker pronounces a word.

In use, each operator calls up his own voice pattern, identified by a reference number set on a control unit. As each word is spoken, it appears on a visual display unit allowing the user to verify, at a glance, that the terminal has correctly understood the communication. An instruction or control word such as 'go' or 'action' from the operator causes the system to despatch the inserted data to the computer installation.

THE INCOMPARABLE SONY 'V-FETS'

Sony's TA Series – A new breed of amplifiers so advanced they lift world standards in fidelity.

SONY research takes the art of solid-state amplification a giant leap forward. Now amplifiers offer all the true warmth and brilliance of the classic vacuum tube without any of its drawbacks. In fact, Sony's V-FETs are the biggest thing in stereo hi-fi since the vacuum tube.

Tubes are inefficient, they deteriorate and wear out. They also require an output transformer to drive speakers. And there's no way they can be set up in true complementary circuits with true wave form symmetry.

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"Watts per dollar" is no longer the test

Amplification goes into a new era, a "V-FET Era" with Sony's new TA series. Both the TA4650 and TA5650 give great power and superb natural fidelity, with literally dozens of applications and facility features, typical of Sony design ingenuity.

To list a few:
Complete FET protection circuits which prevent circuitry or speaker damage, professional controls designed for utmost accuracy and precision, including instant 20db muting volume control and level control memory. Tape monitor and dubbing facilities are thoroughly professional and very comprehensive as are the rear panel connection facilities.

The TA5650 boasts a powerful 50W RMS per channel power output, frequenzy response 10 Hz – 100KHz and a harmonic distortion figure of 0.05% (at rated output). Truly a magnificent performer. From only $500*

The TA4650 delivers a linear smooth 30W RMS per channel, frequency response 10Hz – 100KHz, harmonic distortion an amazing low 0.05%. From only $400*

Whatever your demands, the new SONY V-FET Amplifiers deliver a superb performance with looks to match. Naturally they're perfectly compatible with SONY's new range of space-age Hi-Fi equipment.

If you're into sound, you must be into SONY.

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NEWS HIGHLIGHTS

Electronics industry vital for defence

Continuity of production and research is essential if a viable Australian defence electronics industry is to be maintained and its skilled labour force kept intact, Mr J. A. L. Hooke, the Chairman of Amalgamated Wireless (Australiasia) Limited, said in a recent press statement.

"Stop-start activities are simply not economic and have no place in the future", he said.

Mr Hooke said the Government had shown itself aware of the problems and recently made most welcome initiatives in the field of defence industrial planning.

"The electronics industry today has undergone major changes which greatly increase the difficulty of maintaining a viable defence industry that can be called upon in the event of national emergency", Mr Hooke said. "Recent past policies have greatly reduced the components industry and in-depth manufacturing in Australia, and clearly new policies are required."

Mr Hooke said that virile industries that could swing rapidly from a peace to a war footing must rank with the armed services as being essential to our ability to defend ourselves.

In another recent press statement, the Chairman of the Australian Telecommunications Development Association (ATDA), Mr T. E. Hodgkinson, made a similar plea for the future of Australia's electronics defence industry. According to Mr Hodgkinson, "the telecommunications industry sector employs by far the greatest proportion of electronic engineers and . . . is readily adaptable to the design and manufacture of service equipment."

Mr Hodgkinson said that in the case of a war starting the defence forces will need the active support of back-up industries with the technological expertise to keep the defence system operative. Because of the importance of electronics (in defence equipment) we must have a strong electronics industry . . . if our long term defence aims are to be achieved."

"What will be the use of having adequate armaments if these are to become inoperative in the event of Australia being cut off from the source of supply of essential spares and technical expertise?", Mr Hodgkinson asked. He went on to state that we must stop looking at short term economic advantages and develop our key industries by laying down firm policies.

Low-cost autopilot for small boats

A new automatic pilot capable of steering most pleasure craft and small commercial vessels is now available in Australia through the Marine Division of Amalgamated Wireless (Australasia) Ltd.

The compact, all solid-state autopilot, designated Course Setter 21, is produced by the Benmar Division of Cetec Corporation, USA. It is priced at just $625.

Features of the design include an automatic variable rudder rate design which provides instantaneous correction for course errors as small 0.1°. An automatic rudder trim continually removes trim errors, even on hydraulically steered boats without the need for rudder feedback devices. Side loads, such as trailing nets or single engine operation on dual engine boats are automatically neutralised.

The Course Setter 21 autopilot combines operational simplicity with low cost.

Operation is simple—the helmsman need only select the desired heading and engage the pilot. A remote control handset and a limit switch kit are available as accessories.

Dick Smith secures new supply sources

Gary Johnston, Manager of Dick Smith Electronics Pty Ltd, recently returned from an extensive visit to several Asian countries. Dick Smith and Gary Johnston have both been extremely concerned about the "lamentable" deliveries of electronic components and equipment out of the Asian area recently.

"The CB boom in the United States has tied up production capacity completely in hundreds of factories", Mr Johnston said. "Unfortunately, this increase in demand from the US coincided with a tremendous increase in usage of parts by us.

"Because of the tremendous success of our 1976/77 catalog, issued in this magazine last April, we have been hard pressed to keep supplies up to our mail order customers. This terrible situation should be rectified shortly, however, as we have negotiated with new sources of supply as a result of the trip".

Gary Johnston

Mr Johnston visited Hong Kong, Taiwan, South Korea and Japan while he was away.

American solar energy expert visits Australia

American solar energy expert, Dr Joseph Lindmayer, recently visited Australia to give evidence before a Senate committee on the future possibilities of solar energy. Dr Lindmayer is President of Solarex Corporation, Rockville, Maryland, and at Solarex developed an inexpensive photovoltaic technology that has reduced the market price of photovoltaic systems by a factor of thirty in the past two years.

During a talk given to industry representatives in Sydney last August, Dr Lindmayer outlined the research that was going on, and discussed the potential uses of solar energy. The talk revealed no surprising new facts, revealing instead a steady research program at improving solar cell efficiency and lowering production costs. According to Dr Lindmayer, a great deal of research effort is concentrated on ways of automating production, and producing large area cells.

Dr Lindmayer said that the roof area of the average dwelling was more than sufficient to meet domestic electricity needs, assuming cells of 10% efficiency. His company currently makes silicon solar cells of the order of 15% efficiency. Although these cost somewhere in the $30/watt region, the long term goal is, according to Dr Lindmayer, to reduce the cost to around the 50c/watt mark.

In short term, however, Dr Lindmayer sees a range of consumer applications for solar cells—in torches, transistor radios, wrist watches, pocket calculators, beacons, boats, and street lights, to name just a few. Solarex Corporation is represented in Australia by Transmission Products Pty Ltd, 33 Bellona Ave, Regents Park, NSW 2143.

High Speed Video Tape Printer

Magnetic recording, while highly regarded for its quality and flexibility, has always suffered the disadvantage that there has been no simple way to make duplicates from the original recording. Recently, however, the National company of Japan has introduced a high speed video tape copying system which overcomes this problem.

by PHILIP WATSON

Even in the audio field, the problem of making duplicates in quantity, at a reasonable price, held back the distribution pre-recorded tapes for a long while, in spite of their potential high quality.

Discs can be duplicated in almost any quantity by pressing. The process is cheap and, with modern techniques, virtually loss-free. More important, the time needed to make a duplicate bears little relationship to the playing time of the disc.

The situation is similar for film. Granted, it is a little more complex and losses can be higher if precautions are not taken but, again, the duplicating time is not necessarily tied to the playing time.

But tape? Well, that's always been the hard one. Initially—and until recently—the only way to duplicate any kind of tape has been to re-record it, i.e., decode the information with a replay head, pass it through a suitable amplifier, then feed it to a recording head on the new tape. This is commonly called head-to-head duplicating, or "dubbing".

There are several disadvantages to this system; some obvious, some not so obvious. One of the obvious ones is that, in its simplest form, it takes as long to make the duplicate as it takes to play the master. Where mass duplication is the object this is an intolerable limitation. Another obvious objection is that some loss of quality is inevitable.

This includes both electrical and mechanical losses; transport irregularities in both replay and record mechanisms, signal losses in the amplifying network, plus the natural noise level of the master tape superimposed on the noise of the slave tape.

A less obvious, but equally important, disadvantage is the wear and tear on the master tape, coupled with the wear on the various heads. Both effects add to the cost structure of the exercise.

In the audio field most of these problems, if not actually overcome, have been reduced in magnitude to an acceptable level. The time factor has been reduced by increasing the speed of both tapes by up to 10 times, although this introduces problems of its own. Increasing tape speed by 10 times jacks the signal frequencies up by this amount, so that the amplifying system upper frequency limit has to be similarly upgraded.

To take care of the wear and tear of the master tape this so-called "master" is in reality a duplicate itself, the true master being used only to make second generation masters which are expendable. (Even the true master is only a master in that it represents the final mix-down from the original multitrack recording. Technically, it is also a duplicate.) The final copy will therefore be almost certainly a fourth generation duplicate—at least—with an appropriate accumulation of losses and noise.

Nevertheless, such copies can still achieve a very high standard, partly because the original recordings are that much better than the commercial standard required and partly because progressive improvements in technology have minimised the transfer losses. The technique is in fact the basis of the pre-recorded audio tape industry today.

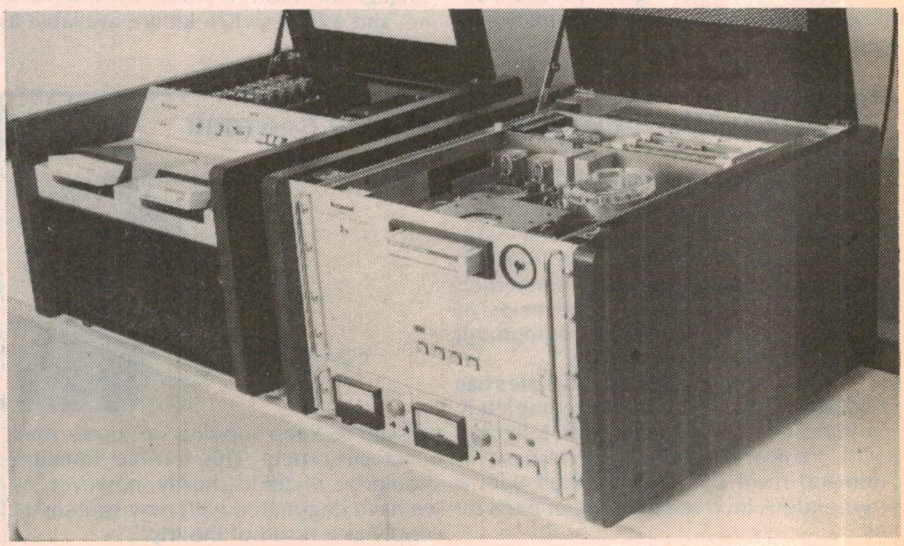
But what of video tape? This is very much a different story. With video signals in the 4.5MHz region any attempt to speed up the re-recording process would call for extremely complex wide-band amplifiers, a difficult requirement to satisfy.

Just as difficult—or perhaps more so—would be the speeding up of the mechanical parts of the system, some of which already operate at quite high speeds.

So, until now, video tape duplication has invariably been on a "real time, head-to-head" basis, with all the disadvantages already discussed, plus some peculiar to the video scene.

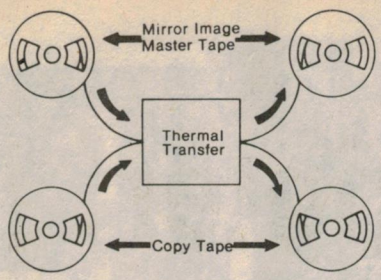
One of these involves the different video systems employed by various countries; SECAM, NTSC, or PAL. To duplicate a tape made to any one of these the duplicating equipment must be designed for that system.

Another, more serious, disadvantage can add to the time needed to make a duplicate. It is possible for various malfunctions to occur during a head-to-head transfer—typically a dirty head—whereby part of the transfer will be degraded or lost. The only way to be completely sure that this has not happened is to replay the entire tape.

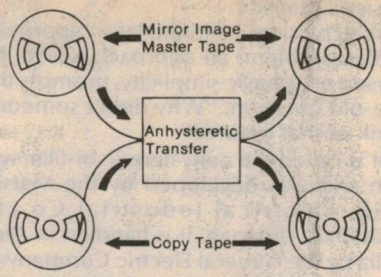


The complete setup for duplicating video tapes. On the right is the special recorder which produces a mirror image master tape from any signal source, including an existing tape. On the left is the high speed duplicator.

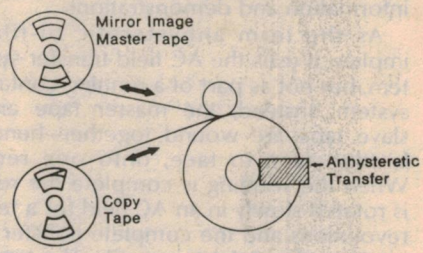
Thermal Transfer System



Anhysteretic Transfer—Running Contact System



Anhysteretic Transfer—Bi-filar System



Three typical tape duplication systems. The running contact systems call for precise transport mechanisms which do not permit relative movement between the two tapes.

On this basis, to duplicate, and check, a half hour recording takes at least an hour of one person's time, plus setting up time. Since this may often be prohibitively expensive, checking may be confined to spot checks with a significant risk of faulty tapes being overlooked.

There have been several attempts in the past to duplicate tapes by another process. Most audio enthusiasts will be aware of—or have actually experienced—the phenomenon called "print through". This is the transfer of information on one part of a tape to an adjacent layer, when conditions are favourable. In practice, it is usually encountered when the signals have been recorded at a higher than recommended level for the particular tape.

This normally unwanted characteristic can be turned to good use. If two tapes are brought into intimate contact, with the oxide faces touching, there will be a more effective "print" from one to the other, though still too low to be of much practical value.

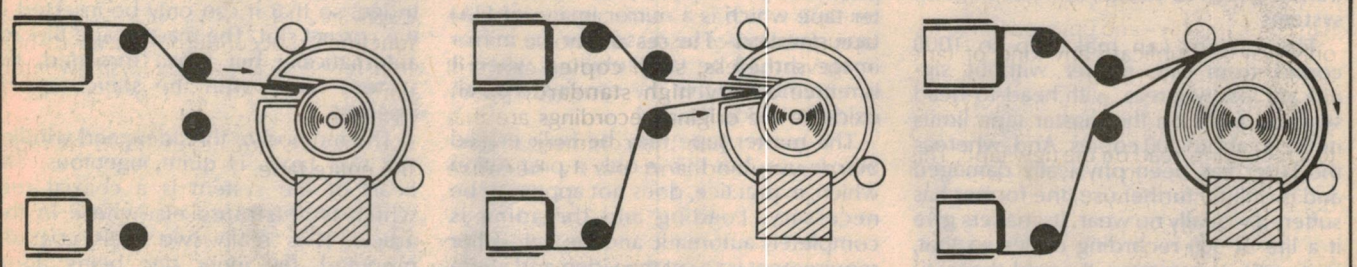
A much more effective transfer can be achieved by two methods. One involves passing the mated tapes through an AC field, the other passing them through a heat cycle which raises the copy tape to its Curie temperature.

A problem with the AC field system is that the field tends to erase both tapes as well as aid the transfer. This is overcome by making the master on a high coercivity tape, while the slave is a relatively standard tape of moderate coercivity. This permits a field strength which gives an effective transfer without significantly erasing the master tape. The broad name for this method is the anhysteretic system.

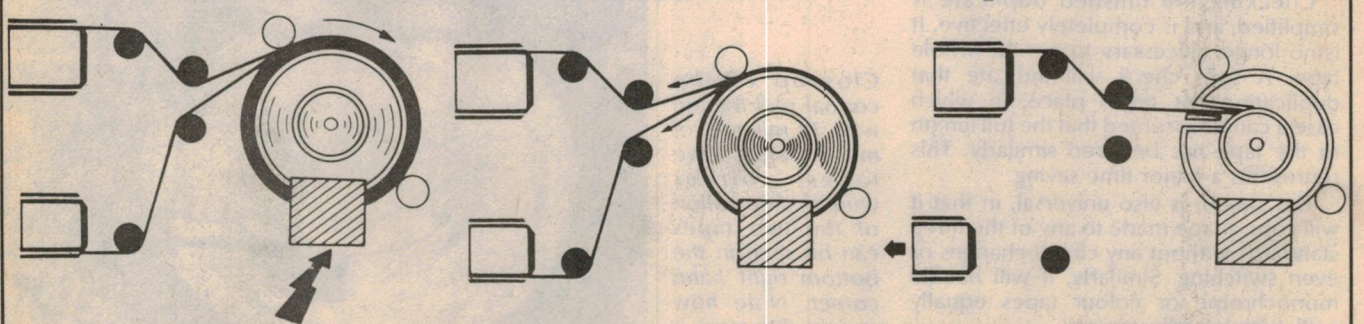
A similar problem exists with the heat transfer—or thermal—process, and it is necessary to use a slave tape with a Curie temperature lower than that of the master tape.

Both systems have been used to date, with some success, all based on the idea of holding the two tapes in contact over a short distance while both are wound at high speed past the transfer device. This is called the "running contact" system.

A major problem with any such system is that of ensuring that all parts of the tapes are held in absolute contact during the transfer, and also that they do not move relative to one another. Either con-



1. Leader tape of the master tape is inserted into the inner reel.
2. Leader tape of the slave tape is inserted into the inner reel.
3. Both tapes are wound tightly together on the outer reel.



4. Transfer field is applied for 3 seconds.
5. Each tape is rewound into its respective cartridge.
6. Copied slave tape pops out. Master tape remains in its compartment for next copy cycle.

Six main steps in making a bifilar anhysteretic duplicate. All steps, including tape threading and capture by the inner reel are completely automatic. Total copying time for a 30 minute tape is about three minutes, most of which is winding and rewinding time, the actual copying taking only a few seconds. One master can make 1000 copies.

dition will result in loss or degradation of signal transfer.

Which brings us to the latest approach to this problem; an approach which, by reason of its basic simplicity, prompts the age-old question, "Why didn't someone think of that before?"

It is called the anhysteretic bi-filar system and was developed by the Matsushita Electrical Industrial Co Ltd (National) of Japan. It is handled in Australia by the General Electric Company of Australia Ltd (Electronics Division) to whom we are indebted for technical information and demonstrations.

As the term anhysteretic bi-filar implies, it uses the AC field transfer system, but not as part of a running contact system. Instead, the master tape and slave tape are wound together—hence bi-filar—face to face, onto one reel. When the winding is complete the reel is rotated slowly in an AC field for a few revolutions and the complete transfer is made in about three seconds. The tapes are then rewound onto their respective reels and the slave tape is ready for immediate replay.

The sound track is transferred on a head-to-head basis, using the high speed techniques already discussed. This takes place during the rewind function.

The total time needed to duplicate a 30 minute tape is only three minutes, all but about three seconds of which is winding and rewinding time.

The makers claim a number of advantages for this system. The obvious one is the saving in time but, equally important, there is virtually no loss of quality in the transfer, such as occurs in head-to-head systems.

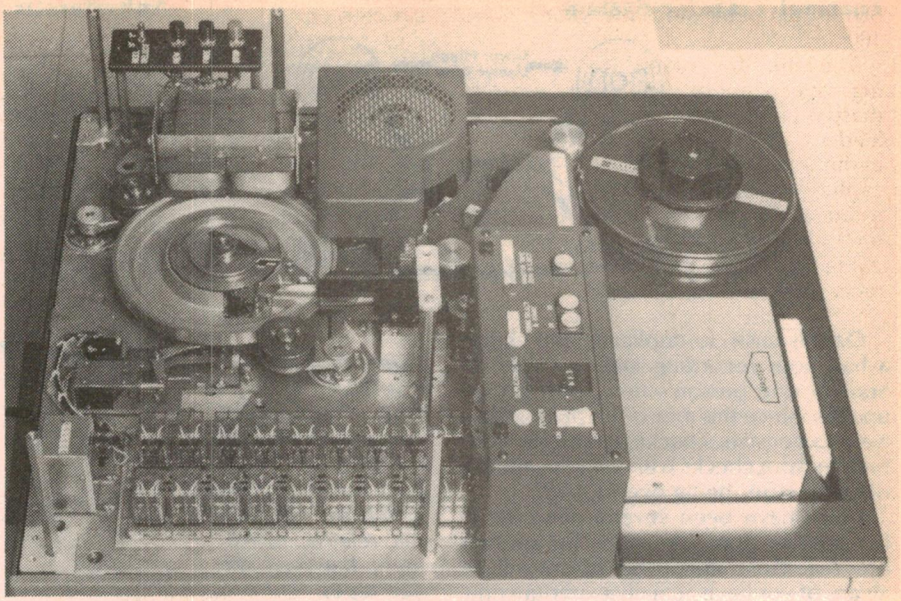
The system can make up to 1000 copies from one master without significant loss whereas, with head-to-head systems, wear on the master tape limits its life to about 200 copies. And, whereas the latter has been physically damaged and is of little further use, the former has suffered virtually no wear. Its makers give it a life of 500 recording cycles so that, in its role as a master, it could theoretically make 500,000 copies!

Checking the finished duplicate is simplified, and is completely effective. It is no longer necessary to run the whole tape. A spot check will indicate that duplication has taken place, in which case it can be assumed that the full length of the tape has behaved similarly. This represents a major time saving.

The system is also universal, in that it will copy a tape made to any of the three standards without any circuit changes or even switching. Similarly, it will handle monochrome or colour tapes equally well, with no adjustments.

There is a much wider choice of tape for the slave function, and no adjustments are needed for different type tapes. With head-to-head recording, changes to bias level, etc, may be necessary for optimum performance.

The equipment is also much more compact and can be used by an unskilled operator following simple instructions.



The open reel version copier with cover removed. The coaxial reel is clearly visible on the left with the AC field magnets directly above it. The master tape (cartridge) and the slave tape (reel) are on the right.

The equipment demonstrated to us by The General Electric Company (GEC) consisted of two units; a master tape recorder and controller and the tape printer proper, both designed for the 0.5in wide tape used for the EIAJ (Electronic Industrial Association of Japan) standards.

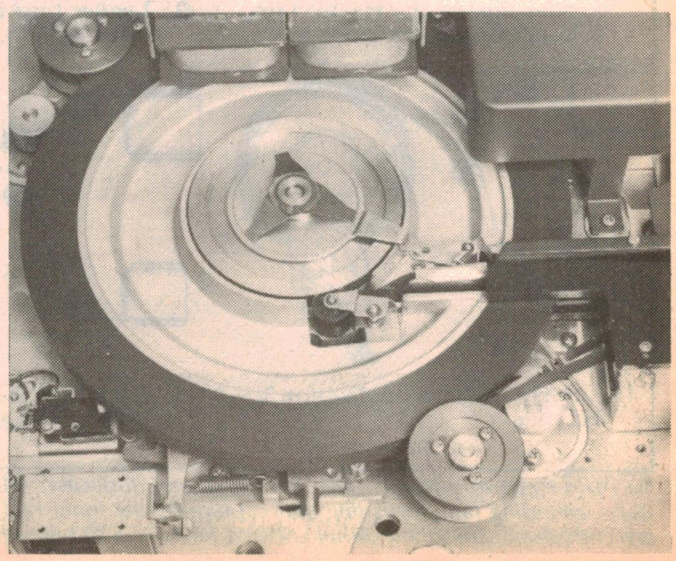
The master recorder will accept signals from virtually any video source; camera, TV receiver, film scanner or video tape player. Its primary job is to make a master tape which is a mirror image of EIAJ tape standards. The reason for the mirror image should be fairly obvious when it is remembered that the copying is on an oxide-to-oxide basis.

The master tape may be bulk erased before use, but this is only a precaution which, in practice, does not appear to be necessary. Loading and threading is completely automatic and the only other requirement is to set the video and audio levels on the appropriate meters on the front panel of the controller.

Both master and slave tapes are in "cartridge" form, although this term is open to debate. More accurately, they are simply the same reels as used in earlier reel-to-reel machines, housed in a box. In fact, they can be removed from the box if it is desired to use them on a reel-to-reel machine.

The finished master is transferred to the copier and inserted in the appropriate slot. This cartridge is deliberately made slightly larger than the slave cartridge, so that it can only be inserted in the correct slot. The master tape threads automatically but, once threaded, the system waits until the slave tape is inserted.

The method of threading and winding the two tapes is quite ingenious. The heart of the system is a coaxial reel, which is illustrated elsewhere in this article. It is really two reels coaxially mounted, the inner one being about



Closeup of the coaxial reel loaded with 30 minutes of master and slave tapes, bifilar wound. Separation of the two tapes can be seen in the bottom right hand corner. Note how evenly the tape is wound.

88mm diameter and the other about 180mm.

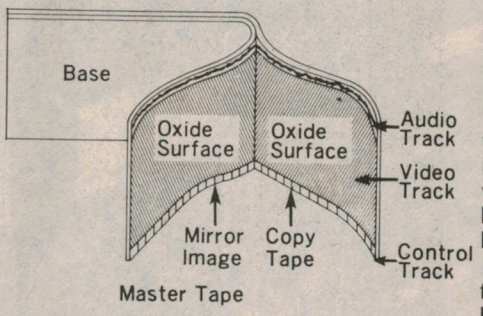
The inner one rotates during the loading sequence and captures, in turn, the master tape leader and the slave tape leader, these being fed to it through a slot in the outer reel. When both leaders are captured the two reels lock together, rotate as one, and wind the two tapes on the ½in wide edge of the outer reel. Two guide pulleys ensure even winding. The reels remain locked until the end of the rewind sequence.

When the outer reel is fully loaded winding ceases automatically, the AC transfer field switches on, and the reel rotates slowly for about three seconds in this field. Both tapes then rewind automatically, the slave tape is ejected, while the master tape leader remains captured, ready to accept another slave.

Two copiers were demonstrated by GEC. One accepts cartridges for both master tape and slave tape. In this unit the slave tape threads automatically. The other unit is almost identical but is designed to accept slave tapes on open reels, as used on some older recorders. The master tape is still a cartridge type and threads automatically, but the slave tape must be threaded manually, though this is quite simple.

Results from both machines are identical and the author can vouch that the slave tape is indistinguishable from the master.

The equipment is beautifully constructed and has obviously been designed to withstand the heavy handling which equipment of this kind has to withstand in the field. It is both robust in the purely mechanical sense, and skilfully designed with the ham handed operator in mind. Carefully thought out interlocks make it virtually impossible for incorrect operation of the controls to cause damage to either the machine or the tape.



The master and slave tapes are wound oxide to oxide. This is the reason the master tape must be a mirror image.

The copier is aimed mainly at educational authorities and similar organisations which have a need to generate and distribute large numbers of tape copies of educational and similar subject matter. At the time of writing the equipment has been demonstrated to educational authorities at all levels, in Queensland, NSW, Victoria, South Australia, and the ACT.

Other possible users would be industrial and sales organisations. At the industrial level, with the increasing complexity of modern technology, it is becoming more and more important that technical staff be regularly instructed or re-trained as new equipment and new processes are introduced.

Audio visual presentation has long been recognised as the most effective means of instruction, and often far safer and less costly than initial instruction on the equipment itself. And tape has the versatility and quality which makes it ideal in many such applications, provided duplicates for distribution to all branches and sections of a company can be made relatively cheaply.

Again, tape is often an ideal medium for sales promotion—provided duplicates can be readily created to cover, say, a nation wide advertising campaign.

On a longer term basis this system, or something like it, may help to establish the video tape player in the home. At the present time the two barriers to the general use of tape players is their relatively high cost and the limited amount of program material available to buy or rent. Even assuming the hardware cost can be reduced, some means of producing adequate quantities of pre-recorded tapes, at a reasonable cost, must still be found.

SC-2002

The True Hi-Fi Front-Loading Cassette Deck. It makes sense.

A well-made cassette tape deck these days gives open reel a good run for the money.

If you're involved with music at the true hi-fi level, here's a reliable one from Sansui. Note:

Front-loading convenience means positioning your tapes right-side up and keeping them vertical and fully visible at all times. Important? You'll discover front-loading saves a lot of tape trouble.

The electronic DC servomotor gives constant speed regulation regardless of voltage changes or tape loads. Independent capstan drive contributes to very low wow/flutter (0.1%). Fully automatic stop and shut-off is even more operating convenience.

The SC-2002 makes sense in other ways, too. Dolby noise reduction ensures recordings made from any source will playback with a drastically reduced tape hiss and noise content.

And such features as output level control, left/right independent recording level controls and wide dynamic range mic circuits contribute to fine sound performance.

The SC-2002 is one of four fine Sansui front-loading decks now available in different styles and price ranges.

When you come right down to it, our true hi-fi components sound so good because hi-fi is the only thing we make.

Maybe this is why we always make sense to people who love music.

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Powerful desktop calculator from Hewlett-Packard

. . . programmable unit features live keyboard

The trend towards powerful desktop calculators is dramatically illustrated by Hewlett-Packard's recently announced model 9825A. This is a programmable calculator with many features previously found only on minicomputers, and is suitable for both process control and stand-alone applications.

The new HP 9825A desktop calculator is designed primarily for use in the fields of engineering, research and statistics. The 9825's speed, interfacing abilities and computer-like features make it particularly well suited for use as the controller of an instrument system, for pilot process control applications, remote data collection and production control.

As supplied in basic form, the 9825 comes with an 8k byte memory. The operating system is hard wired, and is separate from the main 8k byte memory. Optional plug-in ROMs are available to extend the language capabilities of the calculator. For example, a matrix ROM adds standard matrix operators such as inversion and multiplication, plus a large number of multi-dimensional array operators.

Significant features embodied in the 9825 that provide major user benefits include: two-level priority interrupt; live keyboard; direct memory access with input speeds up to 400,000 16-bit words per second; high performance, bidirectional tape drive; multi-dimensional arrays; and automatic memory record and load.

The built-in maths functions provide the standard exponential and trig functions, plus some unexpected additional functions. A random number generator and two kinds of rounding functions provide additional convenience. Accuracy to 12 digits with a dynamic range of 10^{-99} to 10^{+99} and an internal calculation range of 10^{-511} to 10^{+511} are all part of the 9825's capabilities.

The 9825 uses a high level programming language called HPL. This formula-oriented language is easy to learn and ideally suited for controller applications as well as for data processing. HPL handles subroutine nesting and flags, and allows 26 simple variables and 26 multi-dimensional array variables, limited only by the size of the calculator memory.

Edition of lines and characters is simple, and error locations are identified by a flashing cursor in the display. Fixed and floating point formats can be set by the user from the typewriter-like keyboard.

The 9825's keyboard has 12 special function keys that, with a shift function, can handle 24 different operations. The keys help in program writing and in peripheral and instrument control. They can serve as immediate-execute keys, call keys for sub-routines, and as typing aids.

A special feature of the 9825 is the live keyboard, a feature previously not found on a desktop calculator. With the keyboard, the user can examine and change program variables, perform complex calculations, call subroutines, and record and list programs while the calculator is performing other functions.

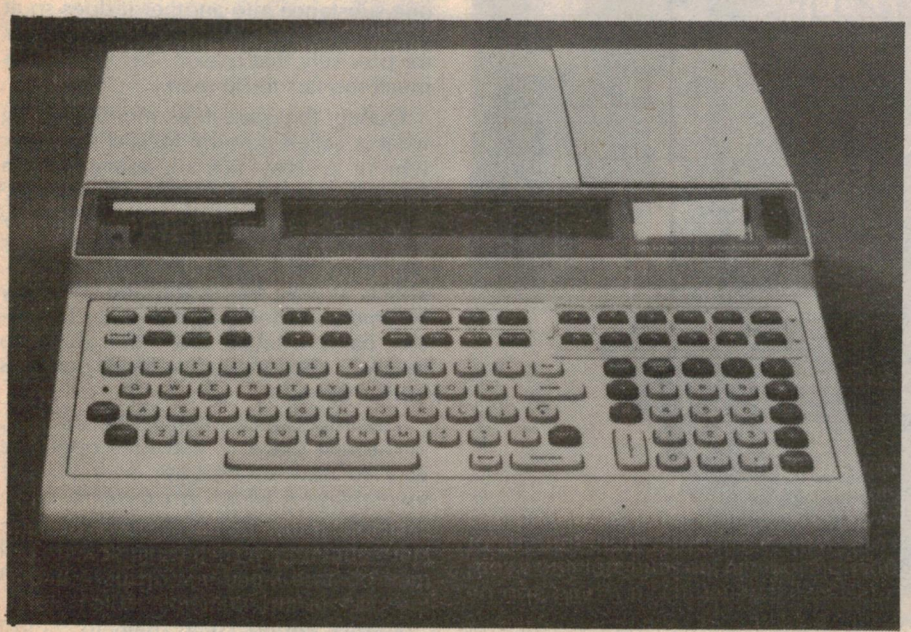
The ability to accommodate a number of tasks simultaneously is another important feature of the 9825. This is known as interrupt ability, and is available in the Extended I/O ROM. The calculator can thus act as a controller for several instruments or peripherals which require attention at unpredictable rates or times.

Data readout from the 9825 is via a new 32-character LED display and a built-in 16-character thermal printer, which provide upper and lower case alphanumeric read-out. The display and printer provide the full ASCII character set. Some European and Greek characters are also available in an optional ROM.

The tape cartridge has two tracks and can hold up to 250k bytes of data. Data transfer rate is 2.75k bytes per second, and automatic verification ensures that important information has been successfully stored on tape.

Using the cartridge, the operator can perform rapid memory load and record operations. In the event of a power failure, this feature, coupled with the "autostart" feature, can reload the calculator's memory and continue whatever program had been running.

The HP 9825A desktop calculator is priced around the $5720 mark (plus sales tax). For further information, contact Hewlett-Packard Australia Pty Ltd.



The HP 9825A programmable desktop calculator can interface with or control a variety of instruments, including printers, paper tape readers and chart plotters.

In the world of the picosecond . . .

New laser may solve bio-chemical mysteries

At London University's Imperial College a research team has developed a laser capable of producing pulses as short as one third of a picosecond. Coupled with the parallel development of X-ray operating frequencies, the new laser promises to open the way to scientific investigation of events that occur at molecular speed, and to provide more detailed molecular structural analysis.

by ANTHONY TUCKER

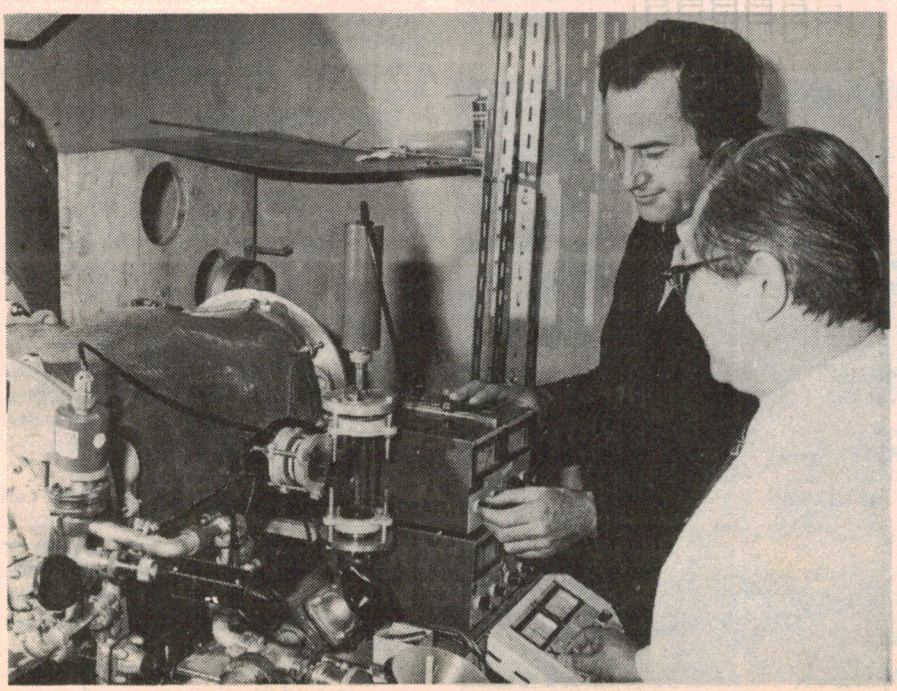
Science correspondent, "The Guardian", London.

The "big" sciences, which need large and costly machines such as accelerators or radiotelescopes, tend to dominate the research expenditure of most countries. But it is cheering, if paradoxical, that many of the most important advances in understanding and technology depend on the insight of individuals working quietly and relatively inexpensively in small laboratories.

Firmly entrenched in this "small" science tradition is a small group of scientists in the optics section of the physics department at Imperial College, London University.

Working under Professor D.J. Bradley, and in conjunction with a small laser-optics group at Queen's University, Belfast, Northern Ireland, they have taken Britain into the lead in the very competitive and rather esoteric world of ultra-short pulses of laser light.

In recent years, lasers have found an enormous numer of applications, for example in range finding, metal cutting and even surgery (the welding of detached retinas). Right now, there is increasing research pressure in three directions: scientists trying to produce lasers of ever greater power; to produce lasers working at ever higher frequencies—thus producing light beams in the ultraviolet and soft X-ray regions beyond the visible spectrum; and to produce pulses of laser light of incredibly short duration.



Professor D. J. Bradley (left) and a member of his research team demonstrate the new laser. Pulses as short as one third of a picosecond can be produced.

These very short times have names of their own, some of which are familiar. A millisecond is a thousandth of a second, a microsecond one millionth, and a nanosecond a thousandth part of a millionth of a second.

A picosecond—and believe it or not this is not the smallest current unit—is a mere millonth of a millionth of a second.

Although the importance of these extremely short times will begin to emerge more clearly as time goes on, the basic reason for their importance in research is that they typify the kind of timescale on which molecular events take place. When, in its miraculous and still mysterious way, a catalyst transforms one substance into another it does so at picosecond speed. It is still mysterious for precisely that reason—for it happens much too fast to be seen.

During the past few months, using what is called a mode locked dye laser whose pulses are measured by a specially modified streak camera, the Imperial College group has consistently produced pulses of light that are only one third of a picosecond in duration. This is at least ten times, and probably 50 times, shorter than any other laboratory has produced. Even the ability to measure such extremely short pulses is itself a triumph.

The importance of such short pulses, in the first place, is that they open the way to new techniques of scientific investigation which promise to open windows on events happening at molecular speed—rather as ultra-high speed photography can "stop" a bullet in flight.

Further, coupled with ability to control the frequency and energy intensity of the beam and using the property of fre-

quency resonance at molecular level, they open the way to new and potentially very specific and very efficient chemical transformations and separations. One of these might be the fusing of hydrogen isotopes to produce helium and large amounts of energy—the controlled nuclear fusion reactor.

However, while it is true that the drive for ultra-short pulse and high energy laser research has stemmed from fusion research, the greatest benefits might accrue from quite different fields. The key timescale of molecular functions (as distinct from structures) is around or less than a picosecond. This is the time it takes for electrons to trigger a process, or for molecules to transform in chemical and photo-biological processes.

One of the most important unsolved scientific mysteries is what happens during those first few fragments of a microsecond of natural absorption of light energy in the photosynthetic process. So far, interpretations have been indirect and imcomplete. Unlocking the secrets of that process alone could provide man with new and powerful routes towards solving both his food and energy shortage problems.

The range of possibilities is large and, with the obtainable wavelengths of laser light shortening all the time (the Imperial College group is already producing laser beams in the hard ultraviolet and expects to produce its first soft X-ray beam within a year or so), the detail that might be observed by ultra-short pulse investigation might be much greater than by other techniques.

Because the amount of information that can be revealed by light as an investigatory tool depends on its wavelength, and the shorter the wavelength the greater the detail that can be revealed, the development of soft X-ray lasers – even without the parallel ultra-short pulse technology – might greatly simplify the task of molecular structure investigation.

At present, and in spite of the aid of automatic systems and computer analysis, the determination of structure rests on extremely difficult and complex interpretation of X-ray diffraction patterns. All present X-ray sources are incoherent – that is, they consist of radiations in a range of wavelengths.

X-rays are necessary because their wavelengths relate to molecular atomic distances and can therefore record the positions of individual atoms, but the range of wavelengths in the beams currently used for necessary structural analysis produce patterns of immense complexity.

The use of coherent X-ray beams, even if these were at first of fairly long wavelength (soft X-rays), would greatly simplify the determination of basic three dimensional molecular structure, providing a tool of greater directness and power than anything so far possessed by crystallographers.

Auto Rhythm Unit For Electronic Organs

Here is the first of a two part article giving constructional details of a rhythm unit for use with electronic organs, or as a self-contained rhythm unit. In this first part the author gives details of a unit capable of simulating eight percussion instruments.

by DAVID EDWARDS

A rhythm section, as used in an electronic organ or similar instrument, consists of three main parts. An oscillator, adjustable in frequency over a suitable range, is used to set the basic tempo of the rhythm, and drives the next section, called the rhythm generator. This consists of a large read-only memory or ROM containing the selected rhythm patterns, and the associated drive circuitry. The remaining part is the instrument simulators themselves, which are triggered by the outputs from the rhythm generator.

The number of bits of ROM memory storage required is determined by the length of the rhythms, the number of rhythms, and the number of instruments required to be driven. With a typical system having eight instruments and twelve rhythms with each rhythm repeating after 32 steps or elementary times, a memory capacity of 8 x 12 x 32 = 3072 bits is required.

While memories of this size can be fabricated from diode arrays, the number of diodes required is prohibitive, and there are also problems concerning physical assembly and reliability. For this reason semiconductor manufacturers have developed rhythm generators using integrated circuit technology, which are a much more practical proposition.

These are now available in single order quantities, and form the basis of the present article. Using these chips, all that is required is a suitable oscillator, power supply and instrument generator. In this article we present a design for eight percussion instrument simulators, and in a future article will give details of the various rhythm generator chips which are available, and how to use them.

The eight instruments which we have simulated are as follows: bass drum, tom tom, low bongos, high bongos, snare drum, short cymbals, long cymbals and maracas. These can all be triggered directly with simple switches, so that it is possible to use them alone, for special effects, as well as in a manual percussions or rhythm section.

The switches used can be simple momentary contact types, arranged in a bank of eight, and operated by hand as a test signal generator. It would also be possible to build the simulator into a console, with a suitable arrangement of switches so that it could be played in a similar manner to a conventional percussion grouping.

Such a console would probably have some foot operated switches, as well as various types of hand operated ones. A complete copy of a percussion grouping could be made, so that the same types of hand and foot movement would be required to "play" it, or a more convenient constructional arrangement could be used, with simple hand or finger operated switches.

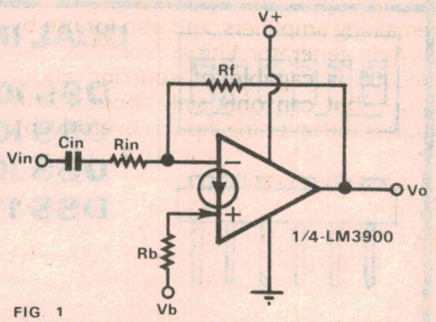


FIG 1

This diagram shows the basic circuit of the LM3900, as used in the instrument simulator.

Another idea would be to use touch operated switches, such as those featured in the March 1976 CDI section, to replace the mechanical switches. This approach may prove to be cheaper, as costly switches will be eliminated.

Organ enthusiasts may also care to experiment with schemes which trigger the sounds when various pedal or manual keys are operated.

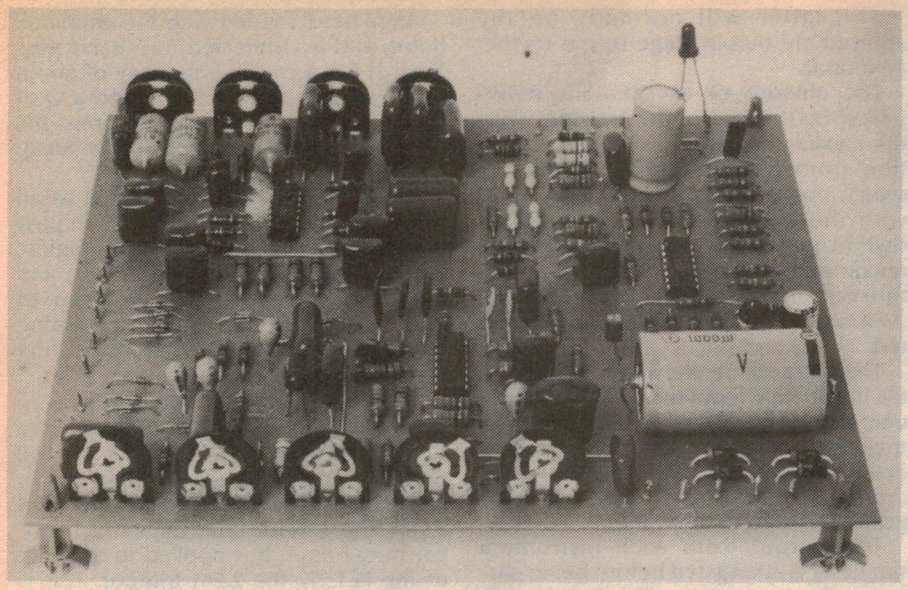
We envisage that if a spare keying line was available, say from the bass pedal section, then this could be used to trip the bass drum simulator, which would then operate when any of these pedals were operated. If such facilities were not available, it may be necessary to provide circuitry which could extract suitable trigger pulses from the relevant audio signals.

Other possibilities include providing an auxiliary manual or pedal board, to operate particular sections of the simulator, or even utilising little used keys or pedals for this purpose. The circuitry necessary for these provisions will of course depend on the particular organ, and its internal circuitry.

We have implemented our design using a quad op-amp IC. We used the National Semiconductor LM3900 device, which contains four current differencing amplifiers. These do not require a split supply rail for their operation. Before discussing the circuit in detail, we will first consider the operation of the basic amplifier, as a good understanding of this will be required to follow the operation of the complete circuit.

Fig. 1 shows a basic AC coupled amplifier. Note the different symbol for the amplifier. This is recommended to avoid confusion with standard op-amps, as basic circuit operation is different. The current source symbol between the inputs implies the current mode of operation, and also signifies that current is removed from the negative input. The current arrow on the positive input indicates that this functions as a current input.

Consider first the DC biasing circuit, formed by Vb, Rb and Rf. Neglecting the input bias current, and remembering that both input are clamped one Vbe above



PARTS LIST

SEMICONDUCTORS

3 LM3900 quad op-amps
1 BC547 NPN silicon transistor, or equivalent
2 2N4360 P channel FETs, or equivalent
1 8.2V 400mW Zener diode
1 30V 400mW Zener diode
4 EM401 silicon diodes
17 1N4148 silicon diodes (see text)
1 red LED

CAPACITORS

1 1000uF 63V pigtail electrolytic
1 470uF 25V PCB electrolytic
1 33uF 35V PCB electrolytic
2 10uF 35V tantalum
4 2.2uF 35V tantalum
6 0.47uF plastic
1 0.22uF plastic
3 0.15uF plastic
3 0.12uF plastic
14 0.1uF plastic
1 0.047uF plastic
4 0.01uF plastic
4 0.0022uF plastic
2 330pF plastic
1 10pF ceramic or polyester

RESISTORS (all ½W rating)

1 10M, 17 1M, 5 470k, 1 330k, 1 180k, 3 120k, 19 100k, 4 82k, 26 10k, 4 6.8k, 1 3.3k, 2 1.8k, 2 1k, 1 270 ohm
3 2.2M trimpots
1 1M trimpot
1 10k trimpot
4 4.7k trimpots

MISCELLANEOUS

1 printed circuit board, 180 x 152mm, coded 76pi9
1 transformer, 240V to 24V, 150mA or larger
printed circuit board pins, insulated PCB standoffs, solder, hook-up wire, tinned copper wire

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with high ratings may generally be used provided they are physically compatible.

ground, we can determine the currents flowing into the inputs. (The inputs are forced to this voltage by the operation of the internal circuit of the amplifier.)

The current flowing into the negative input is given by Vo/Rf, and the positive input current is given by Vb/Rb. The applied negative feedback forces these currents to be the same, so that Vo/Rf = Vb/Rb. Thus Vo = VbRf/Rb, and if Vb = V+/2, and Rf = Rb, then Vo = V+/2.

In other words, if the two resistors are equal, and if the bias supply voltage is half the supply voltage, then the output is biased at half supply voltage too. Of course, the bias voltages source can be used to bias more than one amplifier, as it is required to supply only the combined bias currents.

In similar fashion, the AC gain can be determined, and as might be expected, is given by −Rf/Rin. The input impedance is determined solely by Rin, and is limited only by the input biasing current required by the negative input and by the magnitude of the noise voltage produced by Rin. A non-inverting amplifier can be achieved simply by connecting Rin to the positive input, rather than the negative input.

Before continuing, we should emphasise that the circuits about to be described are basically experimental in nature, in that they can be modified to suit particular needs and tastes. The sound effects are all capable of being "tailored", for example. However, we have designed a printed circuit board for use with the circuit configuration described, which should form a good base from which to commence.

A small power supply has been incorporated on the board, and made available for external use. Our prototype was able to supply in excess of 50mA at +30VDC, and was able to source or sink in excess of 5mA at +15VDC, in addition to the currents taken by the circuitry on the board itself. A transformer with a 24V secondary is required. Higher rated (voltage) transformers can be used, provided due notice is taken of the increased dissipation in the regulator.

Turning now to the main circuit diagram, Fig. 2, we can examine the various sections. The power supply is formed by a simple zener regulated unit. The zener controls a BC547 general purpose NPN transistor, which is capable of supplying currents of up to 100mA. A 33uF electrolytic capacitor ensures adequate ripple rejection.

Amplifier A2 is used to split the supply rail, to supply the bias voltage for the remaining amplifiers, and also for use by rhythm generator chips. Normally, the LM3900 is capable of sourcing about 18mA, but can only sink about 1.2mA (unless the inverting input is overdriven). So to ensure symetrical source/sink characteristics, a 1.8k resistor to ground has been provided. This means that we can sink or source about 9mA.

Amplifiers C1, C2, C3 and C4 are all connected with twin-T networks in the feedback paths, and are used to simulate drum type instruments. They are identical except for the frequency determining capacitors. Output biasing is determined by the 100k, 82k and two 10k resistors, so that the output voltage is approximately +14V.

The bias supply voltage is decoupled by a 1k/470uF resistor/capacitor combination. This prevents interference from other sections of the circuit triggering the drum simulators. This decoupled supply also used to feed other sections of the circuit.

Each drum-effect circuit is adjusted to be just below the point of oscillation by the 4.7k trimpots, so that when excited, a damped, decaying sinusoidal waveform results. The length of the resulting waveform is dependent on the setting of the trimpot, and the frequency on the capacitors used. The 0.01uF capacitor in parallel with the 82k resistor serves to roll off the frequency response above 150Hz. (All four networks operate at lower frequencies than this.)

Excitation pulses are supplied by momentarily upsetting the bias conditions. This gives a predictable amount of excitation, without altering the damping or frequency of the wavetrain. Each input is via an RC combination, and the inputs are intended to be connected to the +30V rail by a mechanical switch or transistor.

The latter will normally be the appropriate output stage of the rhythm generator.

The amount of excitation is determined by the size of the resistor, while the capacitor prevents a further excitation from being supplied when the switch opens again. The diode in series with the input is necessary only for rhythm generators which do not have uncommitted outputs. With uncommitted outputs, and also if mechanical switches are used, the diode can be deleted.

The extra diode shown connected to the high bongo input serves to trigger this unit also when the snare drum input is triggered, to give the full effect of a snare drum. The diode prevents the snare drum from operating when the high bongos are operated, however.

The output from each instrument simulator is attenuated before being passed to the mixer stages. This is necessary to prevent overloading of the mixer.

We have used fixed resistors for the attenuators, although these could be made variable if desired. This may be advantageous if the unit is used as the basis of a percussion group, in which case they could be varied by the player during operation.

The remaining instruments, the low cymbals, high cymbals, maracas and snare drum, all utilise a white noise source, and gain their characteristics from suitable filters, in conjunction with envelope shaping.

Amplifier B4 is used as a non-inverting AC amplifier to boost the intrinsic ouput of the zener diode noise source. The gain is adjusted by varying the 10k trimpot, to give maximum undistorted noise. Note that it may be necessary to adjust the180k resistor used to set the current level through the zener, to obtain a good undistorted noise signal.

A 10pF capacitor is used to restrict the bandwidth of the noise signal to about 15kHz. This is required to prevent slew rate limiting in the following stages.

Amplifier B1 is fed with the amplified noise, and is connected as a band pass filter. It has a centre frequency of about 2kHz, a band pass gain of 1, and a Q of about 1. The filtered noise forms the basis of the snare section of the snare drum.

Amplifier B3 is also connected as an active filter, but this time as a high pass filter. It has a gain of 1 in the pass region, a corner frequency of about 2kHz, and a Q of about 1. Its output signal serves as the basis of the three remaining instruments, the short cymbals, long cymbals and maracas.

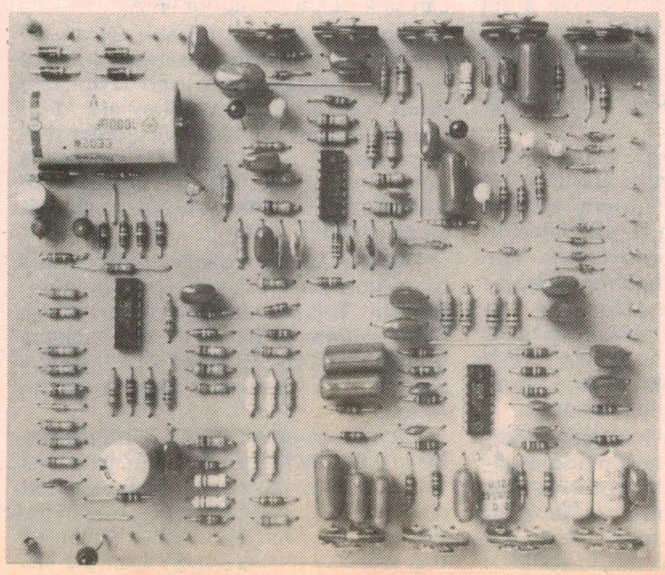
Two P-channel FETs are used to control the amplitudes of the filtered noise signals. For the snare drum, a control pulse is generated when the input is connected to the +30V rail. This pulse has a very short attack time, but a much longer decay time. It is applied to the gate of the FET by the 2.2M trimpot. This is adjusted so that at maximum pulse amplitude, pinch-off is only just achieved.

Thus the noise signal at the source of the FET rises rapidly to a peak, and then decays slowly. As with the drum instruments, the input diode is not necessary for open drain type switches.

The long and short cymbal control signals are generated in a similar manner, and applied to the gate of the second FET by diodes. These diodes prevent interaction between the instruments. The maracas signal differs in that it has a much longer rise time, so that the resulting noise signal rises and falls in intensity at a much lower rate.

The controlled noise signals are then summed in amplifier B2, before being attenuated and passed to the mixer. This is composed of amplifiers A3 and A4, and has three outputs, Right, Left and Mono. The mono signal is 20dB lower in intensity than the other two signals.

Ten resistors are provided, enabling the five inputs to be spaced across the stereo image. The values we have chosen can be varied if required. The mono sig-



LEFT: Use this photograph of the completed board assembly as an aid to construction. Note the use of circuit board pins for all external connections.

RIGHT: This circuit diagram shows all the components which are mounted on the printed circuit board. The twelve op-amps are contained in only three packages.

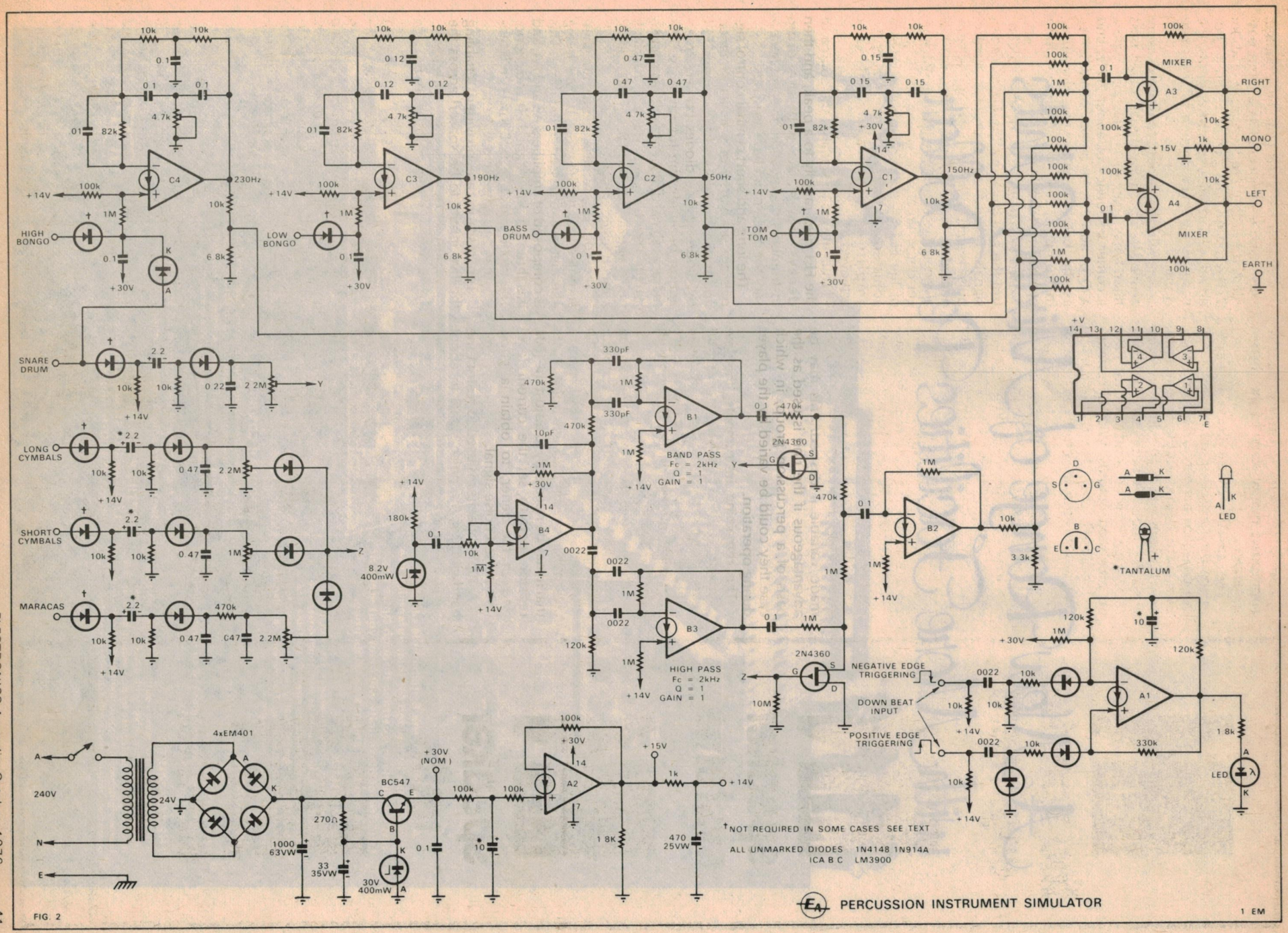
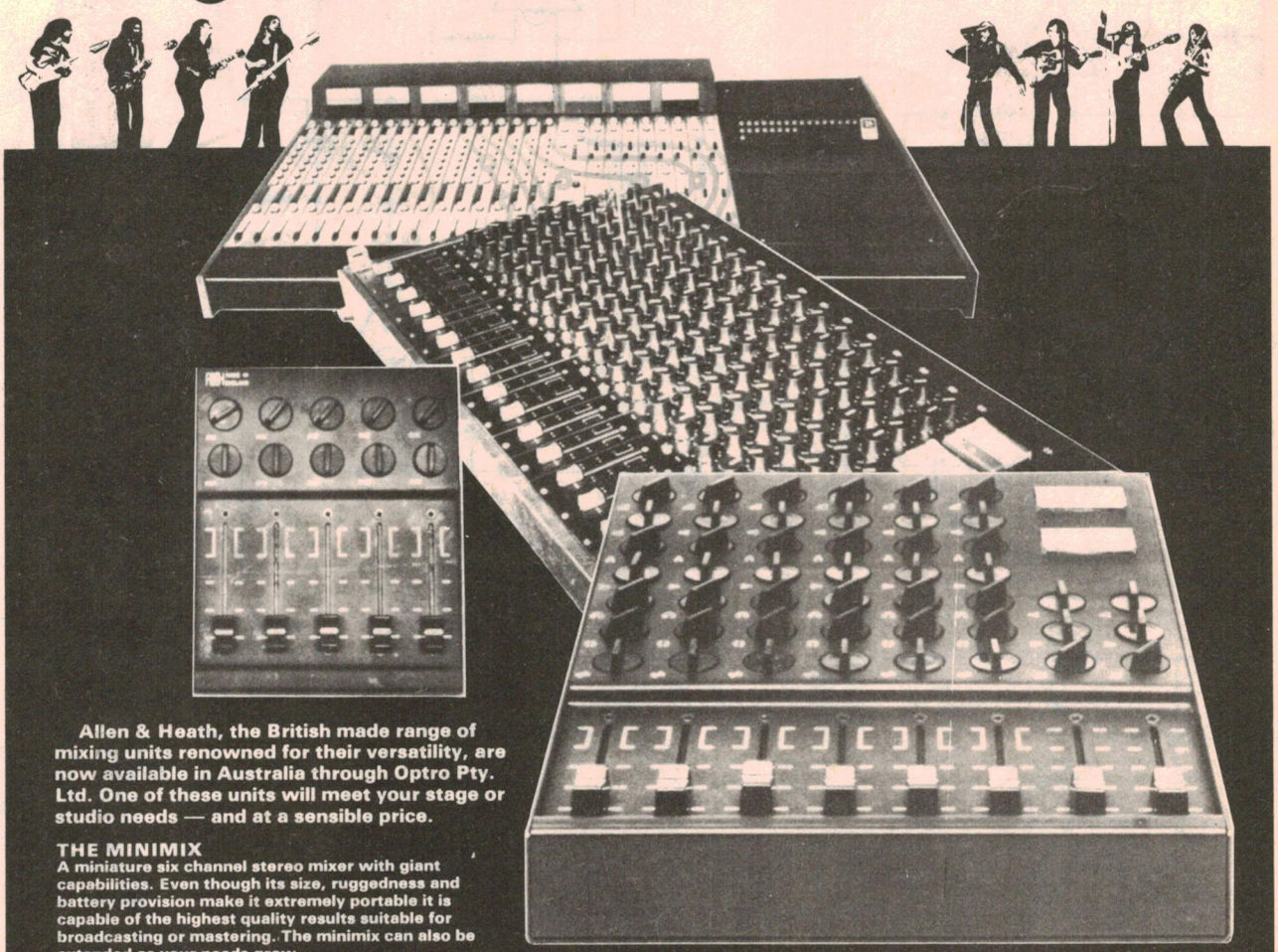


FIG. 2

PERCUSSION INSTRUMENT SIMULATOR

1 EM

A New Range of Mixing Units with More Facilities Per Dollar



Allen & Heath, the British made range of mixing units renowned for their versatility, are now available in Australia through Optro Pty. Ltd. One of these units will meet your stage or studio needs — and at a sensible price.

THE MINIMIX
A miniature six channel stereo mixer with giant capabilities. Even though its size, ruggedness and battery provision make it extremely portable it is capable of the highest quality results suitable for broadcasting or mastering. The minimix can also be extended as your needs grow.

THE MONMIX
A five channel line stereo mixer.

THE AUXBOX
Designed for studio conditions when several auxiliary facilities become necessary.

THE POP-MIXER
A 16 channel (max.) stereo output, modular, portable sound reinforcement mixer with a host of special features. It's ideal for use by pop groups because it is lightweight, small, rugged, compatible, positive in operation, reliable and professionally presented.

MODULAR CONSOLE
This unit features all the sophisticated functions that the recording engineer needs for up to sixteen track recording and mixdown. These facilities are coupled with modular construction for easy expansion.

For full technical information on any unit contact the sole Australian agent —

OPTRO PTY. LTD.
17 Arrawatta Street, Carnegie, Victoria
Phone 569 0978, 569 0979

OPTRO PTY LTD

nal is produced by summing the left and right signals across a 1k resistor.

The remaining amplifier, number A1, is used to drive a LED, as a downbeat indicator. It can be triggered from either a positive or negative going input pulse, and turns on the LED for about 350ms. The printed circuit board overlay shows the connections required for negative edge triggering. To obtain positive edge triggering, simply change the 10k resistor connected to ground for a diode, and place the input diode in the alternative position.

Assembly of the components on to the PCB should not be difficult. The PCB is coded 76pi9, and it measures 180 x 152mm. As you can see in the photograph, all the trimpots are mounted on the edges of the board. Input and output points are also at the edges of the board.

We recommend the PCB stakes be used for all connections to the board. This will prevent the fine tracks from lifting due to mechanical strain. Commence construction by fitting them, and then fit the five links, which need not be insulated.

Next fit all the resistors to the board. These are all ½ watt types, and should be mounted close to the board. It will

This is a full sized reproduction of the PCB pattern, shown from the copper side, and can be traced if desired.

help later troubleshooting if they are all aligned with the colour bands oriented similarly, so that the values can later be read off easily.

Now fit all the smaller capacitors, as well as the diodes and transistors. Pay particular attention to the orientation of the tantalum and electrolytic capacitors, as well as the orientation of the diodes. the larger capacitors should be fitted last, so that they do not interfere with the mounting of the smaller components.

The remaining passive components can now be fitted, and the board then checked thoroughly for mistakes. Once you are sure that all is OK, the three integrated circuits can be fitted. These do not require sockets, and can be soldered directly to the board, using a minimum of heat and solder.

The board is now ready for testing. You will require a 24V AC supply, a stereo amplifier and speakers, nine momentary contact switches, four 10k resistors, four 1k resistors, and some shielded cable. If an AC supply is not available, a 35V DC supply will suffice.

First, set all trimpots in the extreme anti-clockwise position, when viewed from the edges of the board. Connect up the supply, and monitor the voltage on the emitter of the regular transistor. This should be about 30V. Then check the voltage at the +15V output terminal, and the voltage on the filtered +14V rail. This is available at the link above IC "C".

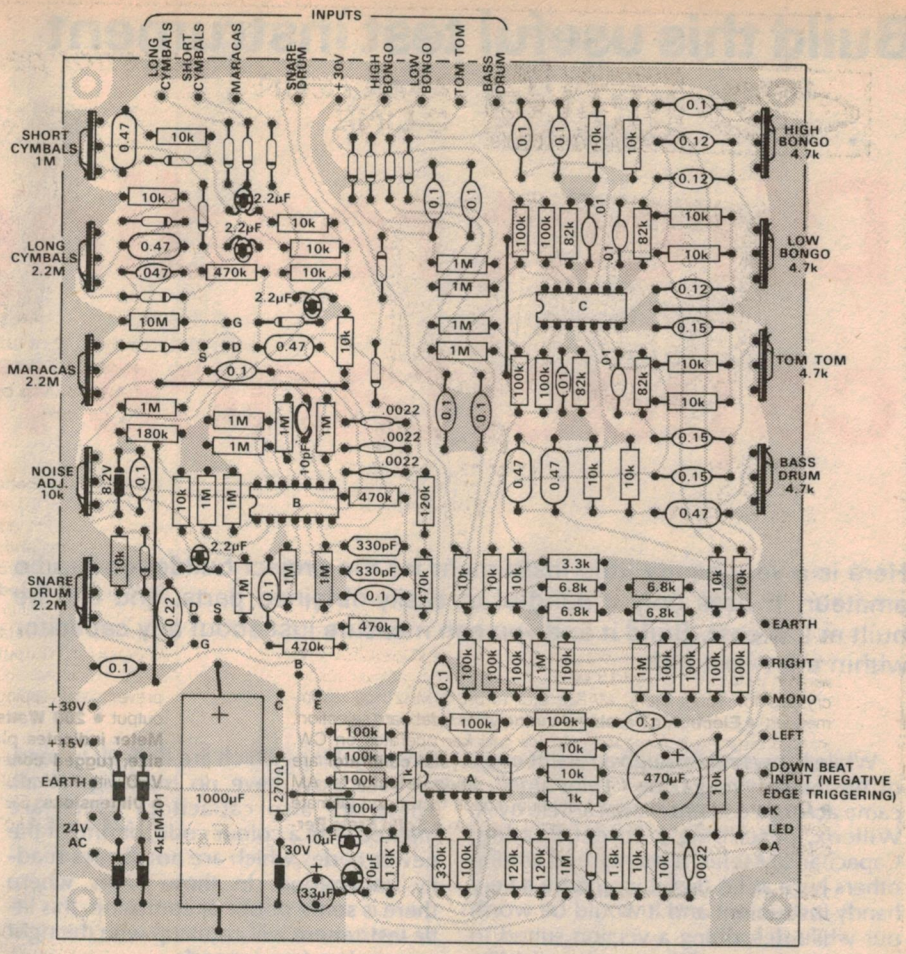
Now remove the supply. Connect the four 10k resistors to the drum inputs, and the four 1k resistors to the noise inputs. Then, using shielded cable, connect the free end of each resistor to the +30v rail (available between the two sets of inputs) via the switches.

The shields are used as the connector to the +30V rail. The remaining switch is connected between the +30V rail and the downbeat input. Mount the LED on the output terminals, with due regard to polarity.

You may require isolating capacitors for the inputs to the amplifier. If in doubt, fit 0.1uF plastic types in series with the active leads. The common lead connects near the right input.

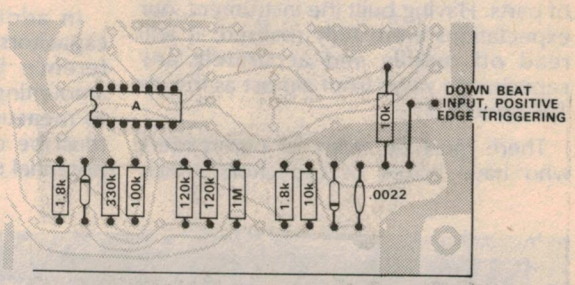
Now apply power again, and check the operation of the downbeat LED. If you have fitted negative edge triggering, the LED should emit when the switch is released, and should last for about 350ms. Conversely, if you have fitted positive edge triggering, it should emit when the switch is closed. No clicks should be heard in the speakers when the downbeat is operated.

The drum synthesisers are next on the checklist. Sounds should be produced when all four drum switches are operated. The length of each sound can be adjusted with the appropriate trimpot.



ABOVE: Use this overlay diagram as an aid to the placement of components. It is for the negative going downbeat input.

RIGHT: This section of the overlay shows the components which need to be changed for the positive going downbeat input. Other components remain the same.



Care is required while making these adjustments, however, as if the twin-T circuits oscillate, very loud continuous sounds will be produced.

The actual length required is a matter of judgement. It helps if you are musical, or have a good memory for sounds. We found that the best effects were obtained if the lower frequency drums were adjusted for "thumps" rather than "rings".

You should now be ready to adjust the remaining circuits. Leave the noise adjusting trimpot in the maximum anti-clockwise position, and while triggering each input in turn, adjust the appropriate trimpot. The long cymbals, short cymbals and snares should be set so that there is no period of constant intensity sound before the decay starts. Do not trigger the inputs too rapidly, as otherwise the correct sound will not be obtained.

When the snares are adjusted, readjust the high bongo trimpot so that the drum sound lasts as long as the snares. You should, at this stage, have discovered that when the snares are triggered, the high bongos also sound.

The maracas are adjusted in a similar manner to the cymbals, so that they rise to a peak fairly slowly, and then commence to decay again immediately. Once all instruments are working correctly, adjust the noise trimpot so that a suitably balanced sound is obtained.

Do not set this level too high, as otherwise slew rate limiting may occur in amplifier B4. This will cause a sudden increase in distortion, and is best avoided.

Your instrument simulator is now operational, and can be connected up as you desire. Details will be published in next month's issue of the various rhythm generator chips available, and how to use them with the percussion unit. Alternatively, you may care to experiment with some of the possibilities mentioned earlier in the article.

Build this useful test instrument

Direct reading capacitance meter

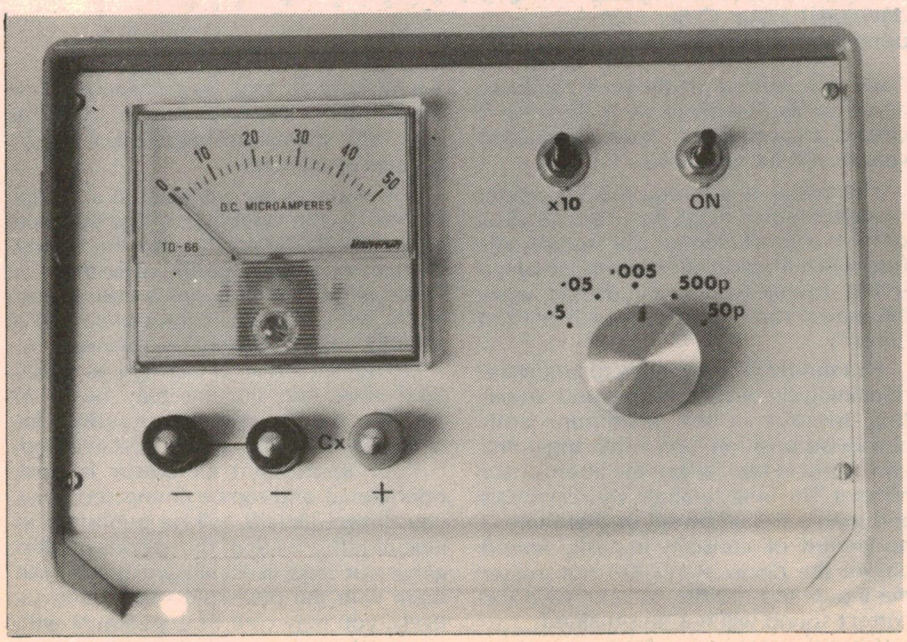
Here is a very handy little instrument for the project builder and radio amateur. It uses only a handful of easily-obtained parts, and can be built at low cost. Build it and you can measure just about any capacitor within a few seconds.

by IAN POGSON

While browsing through a recent copy of the English magazine "Television", I came across a constructional article by A. Willcox, describing a Direct Reading Capacitance Meter. It was agreed among others here at EA that it would be a very handy instrument and it would be worth our while describing a version suited to our Australian conditions and availability of parts. Having built the instrument, our expectations were fully realised; it will read off readily and accurately any capacitance value from almost as low as 1pF up to 5uF.

There must be many of our readers who have boxes of capacitors which have markings which are difficult to read, or even now have no markings at all. There are also capacitors which are marked with a colour code, or one of the newer codes which are not always readily understood. In these cases where there is some doubt or confusion, this little instrument will come up with the right answer in a few seconds.

In addition to measuring ordinary capacitors, as there is a potential difference between the two terminals amounting to a volt or two, it is possible to measure electrolytics. The polarity must be observed of course. Also, this potential difference makes it possible to measure the reverse biased capacitance of diodes, at the voltage appearing across the terminals. This is not all. Such other capacitance measurements as the junctions of transistors, coaxial cable, etc may also be made.



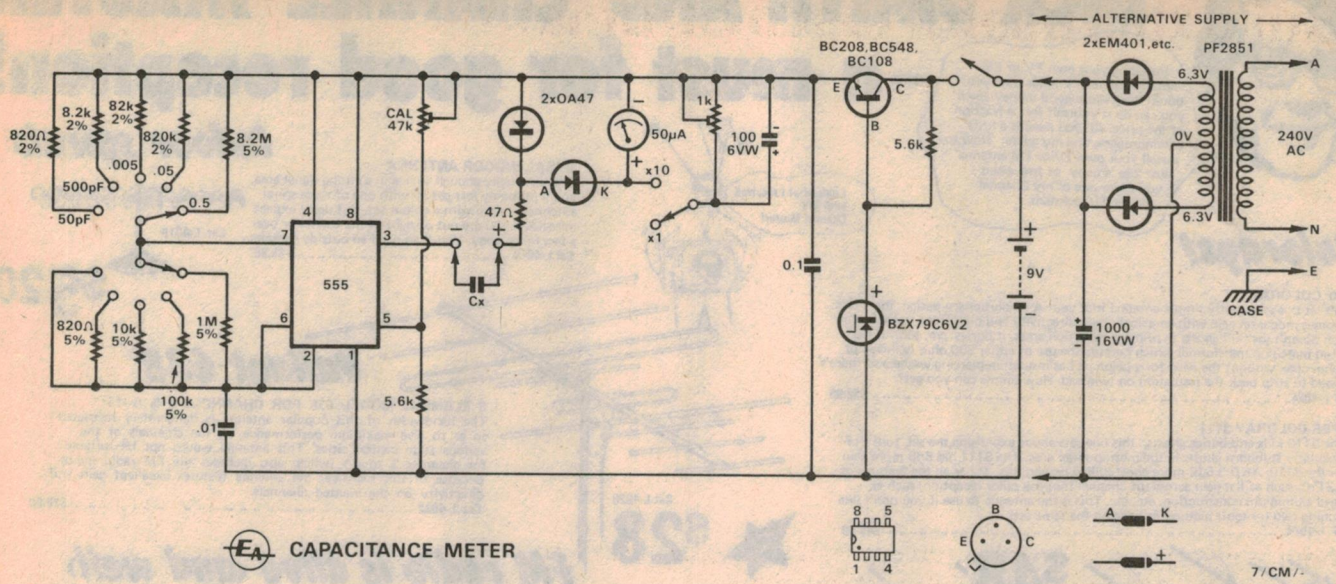
Above is a photograph of the completed capacitance meter. A standard plastic case with an aluminium front panel was used to house the prototype.

The device is quite simple, as may be seen from the circuit and the pictures. Following on from this, the cost is quite modest on current standards. The operation of the circuit is centred on the ever popular 555 timer IC. I will give a very brief description of the operation, but for readers who would like to go into this at a greater depth, I suggest that you refer to the original article by Mr Willcox, in the May, 1976 issue of "Television".

The two resistors selected by the range switch, together with the .01uF capacitors and part of the 555 timer, form an oscillator. After undergoing switching in other parts of the 555 timer the output emerges at pin 3 in the form of pulses. One part of the pulse is discharged through capacitor Cx, via the diode to the supply rail. The other part of the pulse discharges through the other diode and the meter. These pulses are integrated by the meter and give a reading in accordance with the capacitance Cx.

Calibration is achieved by adjusting the 47k trimpot, on any one of the ranges. This means that all other ranges will be correct, provided that all resistors of other ranges are close tolerance types. In point of fact, the four top resistors are important in this regard and 2% or better are advised. However, the 8.2M value is not readily available in such a close tolerance and 5% is normally used under these circumstances. Needless to say, we would not calibrate the device on this range.

The bottom row of switched resistors



are not so important and 5% tolerance values are sufficient here. It will also be noticed that three resistors relate by a factor of 10, but the fourth resistor is reduced to 820 ohms and the fifth position is reduced to a link. These are due to the effective resistance presented by the IC at pin 7.

In order to increase the top range measurement of 0.5uF by a factor of 10, a shunt in the form of a 1k trimpot is switched across the meter. Due to the low frequency of the oscillator on the top range the pointer of the meter is inclined to "jitter", so a 100uF electrolytic capacitor is also switched across the meter with the trimpot to eliminate this effect. Of course, when switching out the x10 facility, the jittering effect remains on the top range. It is not serious but, if you wish, the next lower range may be selected and the x10 switch added, again resulting in a 0.5uF range but with smooth meter operation.

To maintain accuracy of measurement, it is necessary to keep the supply voltage rail at a steady voltage. To this end, we have used a simple voltage regulator consisting of a 6.2V zener diode and a BC208 (or similar) transistor. It was found that this arrangement was slightly unstable under certain conditions and the 0.1 bypass capacitor was added to cure this tendency.

The prime supply for our unit is a small 9V battery, regulated by the circuit just mentioned. However, if you wish to operate the unit from the mains, then the battery may be placed in the circuit by the alternative consisting of a transformer, two diodes and an electrolytic capacitor. The On/Off switch should then be shifted from its present position to the primary of the transformer.

It seems that there can be problems these days in getting all the right components for any project of this kind. I have already mentioned the requirements for the resistors, particularly with regard to tolerance. Unfortunately, I had trouble in getting close tolerance resistors in some sizes and as deadlines will not wait, I had to accept wider tolerances where necessary, rather than spend time chasing around elsewhere. This did result in some deviations from the expected accuracy on one or two ranges. However, this is just by way of illustration and I understand that my supplier now has a full range of close tolerance resistors.

OA47 or similar gold bonded germanium diodes are requisite but supplies of these still seem to be readily available. The case used to house the instrument should also be available through your supplier, but any case of your choice may be used. The meter is a current type and this and the rest of the components should be readily available.

Construction is not critical but one or two points should be observed to get best results. The most important lead in the device is that from the junction of the two OA47 diodes, via the 47 ohm resistor to the + terminal for Cx. Stray C between this lead and large objects will cause a zero error on the 0 to 50pF range. By keeping this lead as short as possible, the majority of error in our case is due to the capacitance between the metal panel

LIST OF COMPONENT PARTS

1 Case 184mm x 115mm x 118mm, with aluminium front panel (Aust Transistor Co)
1 Meter, 50uA, 65mm x 60mm
1 Rotary switch, 2-pole 5-position
2 Toggle switches, SPDT
1 EA multi-dip board (see text)
3 Jabel terminals, 1-red, 2-black
1 Pointer knob
1 IC, 555 8-pin DIL
1 Socket for IC
1 Transistor, BC208, BC548, BC108
2 Diodes, OA47 germanium gold bonded
1 Zener diode, BZX79C6V2
1 5-tag miniature tag strip
1 9V battery, No 2362 (optional)
1 Power transformer, 240V to 12.6V CT, PF2851 or similar (optional)
2 Diodes, EM401 or similar (optional)

CAPACITORS
1 .01uF 200V greencap
1 0.1uF 100V greencap
1 100uF 6.4VW electrolytic
1 1000uF 16VW electrolytic (optional)

RESISTORS (½ watt unless stated otherwise)
1 820 ohms 2%
1 8.2k 2%
1 82k 2%
1 820k 2%
1 47 ohms 5%
1 820 ohms 5%
1 10k 5%
1 100k 5%
1 1M 5%
1 8.2M 5%
2 5.6k 10%
1 1k trimpot
1 47k trimpot

SUNDRIES
Hookup wire, solder, lugs, screws, nuts, 3-core flex and plug (optional).
Note: Resistor wattage ratings and capacitor voltage ratings are those used on the prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower ratings may also be used in some cases if available, providing ratings are not exceeded.

DICK SMITH AND CHANNEL MASTER —a must for good reception!

Installing your own TV or FM antenna is much simpler than you think! Why waste good money when you can do it yourself for a fraction of the price. All you need is a little commonsense, and my guide: 'How to install your own TV or FM antenna' Just 25c a copy or free when you order one of my Channel Master TV antennas.

Indoor spirals

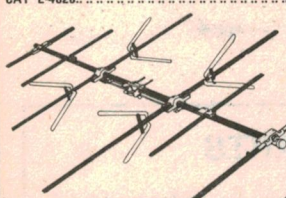
SPIRAL INDOOR ANTENNA
If you're lucky enough to live in a strong signal area, you'll probably *just get by* with one of these spiral antennas — even with a colour set. But don't expect miracles if you are out of sight of the towers or over a few miles away. You then need an outside antenna.
Cat L-4010 ..... $5.20

$5.20

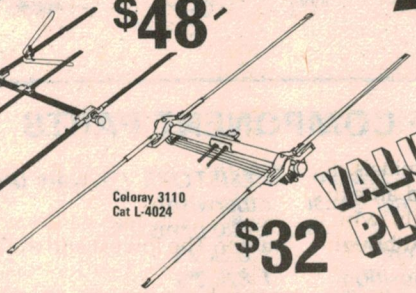
Colorays!

3110 COLORAY
Don't let this apparently simple antenna fool you! A revolutionary design, the 3110 combines moderate gain with amazingly high directivity and high front-to-back ratio which doesn't just kill ghosts in primary reception areas, it buries 'em, too! It has a built-in matching transformer which permits the use of either 300 ohm twinlead or 75 ohm coax without the need for a balun. It has insulation-piercing washers so there's no need to strip back the insulation on twinlead. How simple can you get?
CAT L-4024 ..... $32.00

SUPER COLORAY 3111
If the 3110 kills and buries ghosts, this one sets about exorcising the set, too! For particularly stubborn ghosts in the metropolitan area. The 3111 has 5dB more gain than the 3110, AND 3.5dB more ghost-killing power, too. It has all the features of the 3110, such as flat gain across the channel for peak color reception; such as rugged aluminium construction, etc, etc. This is the antenna to use if you don't like watching two (or ten!) pictures at once on the same set.
CAT L-4028 ..... $48.00



$48



$32 VALUE PLUS!

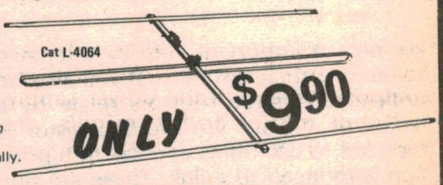
$28

Valiant 638

8 ELEMENT MODEL 638 FOR CHANNELS 2 & 6—11
The bandwidth of this popular antenna is deliberately restricted so as to give maximum performance on the channels of the various state capital cities. This antenna would not be suitable for channels 3 to 5A (which also includes the FM radio band) Because of this sacrifice, the antenna features excellent gain and directivity on the wanted channels.
Cat L-4020 ..... $28.00

FM radio is alive (and well)

3 ELEMENT FM ANTENNA
You *can* run your FM tuner from the TV antenna or a simple dipole hoisted up the wall, but you wont get optimum results. For just a few dollars, you can erect an antenna specifically designed for the FM bands (and your tuner will reward you for it!) This 3 element antenna is designed to cover the full 88-108MHz FM band (*just in case we ever happen to get more stations!)* and can be mounted vertically or horizontally.
Cat L-4064 ..... $9.90

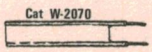


$9.90 ONLY

ACCESSORIES & BITS

You may need something to get the signal down to the set...

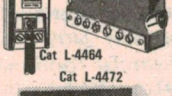
300 OHM RIBBON (TWINLEAD) Does not unduly attenuate signal, but must be carefully routed to avoid metal, etc, which affects impedance.
Cat W-2070 ..... 15c/metre. Bulk price 100m or more 8c/m.



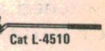
75 OHM COAX CABLE Slightly higher attenuation, but not as prone to ghosting or impedance change. Ideal for color installations and 'trouble' areas.
Cat W-2080 ..... 30c/metre. Bulk price 100m or more 20c/m.

And if you want to run more than one TV...

4 SET TV/FM COUPLER If you want to run TV sets or tuners from the same aerial, use one minimum loss and interaction. 300 ohms impedance.
Cat L-4220 ..... $3.50
2 SET TV/FM COUPLER As above but for 2 sets **Cat L-4218 ..... $2.50**
4 SET TV/FM COUPLER As above but 75 ohms impedance **Cat L-4474 ..... $4.00**
2 SET TV/FM COUPLER As above but for 2 sets, 75 ohms imp. **Cat L-4472 ..... $3.00**
FM/TV SPLITTER This useful accessory splits the incoming 300 ohm twinlead into 3 different signal leads: VHF TV; UHF TV & FM Radio.
Cat L-4210 ..... $3.50
3 WAY ANTENNA SWITCH Attaches to the back of the TV set and allows up to 3 different antennas to be used for troublesome areas or long distance reception.
Cat L-4232 ..... $3.50
BALUN — 75 TO 300 OHM Allows you to use coax (for less ghosting) with sets of 300 ohms input impedance. Can also be used as an antenna balun (300 — 75 ohm) if waterproofed.
Cat L-4464 ..... $2.00

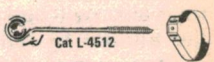


WOODSCREW STANDOFF Holds ribbon or coax flat, but out from walls and gutters, etc. Stops it flapping around in the breeze.
Cat L-4510 ..... 25c each; 10 or more 20c each

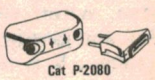


NAIL-IN STAND OFF For ribbon only, lets you run it neatly along skirting boards, etc. Gives a neat, professional job.
Cat L-4514 ..... 25c each, 10 or more 20c each

STANDOFF ASSEMBLY Use for standing off masts, etc. Complete with strap assembly (holds ribbon or coax).
Cat L-4512 ..... 70c each, 10 or more 60c each



RIBBON WALL PLUG & SOCKET Designed to mount on wall or skirting board, gives professional looking connection.
Cat P-2080 ..... 60c



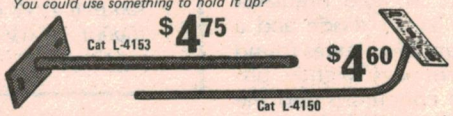
75 OHM WALL SOCKET Mounts on wall or skirting board. Saves tripping over trailing leads when the set is not in use.
Cat L-4504 ..... $1.75

FLUSH MTG 75 OHM WALL SOCKET The deluxe job. Clean, flush fitting — designed for wall or skirting board mounting.
Cat L-4053 ..... $3.25

75 OHM COAX CABLE PLUG Terminates coaxial cable neatly and properly. Suits the 75 ohm wall socket.
Cat P-2020 ..... 50c

TV ANTENNA CLIP Quick way to connect lead-in to set. Ideal when using portable sets. Strong plated springs with screw terminals & plastic handles.
Cat L-4236 ..... 40c

Then, of course, the antenna cannot stay in mid-air by itself. You could use something to hold it up?



$4.75 $4.60

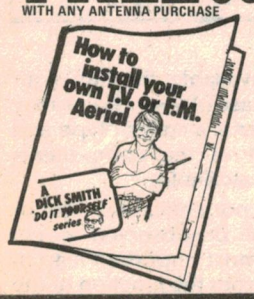
$3.40

BARGE BOARD MOUNT: This is designed to mount practically any TV antenna from a vertical surface (such as a wall, barge board, chimney, etc) It is 55 inches (1.4m) long.
Cat L-4150 ..... $4.60
CHIMNEY MOUNT: Use the brick chimney to gain extra height and stability. This is a double arm, single strap, easy to mount unit. Complete with mast mount assembly.
Cat L-4154 ..... $6.80
WALL MOUNT: This can be used for wall or barge board mounting of a vertical mast up to 2 inches (50mm) in dia. Complete with 'u' bolt and nest assembly. 11 inches (28cm) long.
Cat L-4152 ..... $3.40
WALL MOUNT: Similar to previous unit, but 27 inches (68cm) long, to help clear wide eaves, etc. Also complete with 'u' bolt and nest mounting assembly.
Cat L-4153 ..... $4.75

$6.80

FREE*...

WITH ANY ANTENNA PURCHASE



HOW OFTEN DO YOU SEE SOMETHING FREE THESE DAYS?

This handy do-it-yourself guide to correct TV & FM antenna installation.

PLANNING TO PUT UP AN ANTENNA?

As Dick says, it is simple to do *but* there are a few pitfalls — traps for young players, if you like. Don't fall into them — let this do-it-yourself guide from Dick help you out. It's free when you buy an antenna from Dick. If you've got an antenna, and you've got problems, this guide can also help you out. Purchased separately, its 25 cents. That's 25c which could save you a lot of time and effort, not to mention eye strain on a crook picture!
Cat B-4500 ..... 25c *
*** or free with any antenna purchase. Please request.**

DICK SMITH DEALERS :~

Dick Smith Dealers carry many of our products — Prices may be slightly higher to cover freight costs.

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Interstate Branches: QLD. ~ 166 Logan Rd., Buranda, 391 6233.
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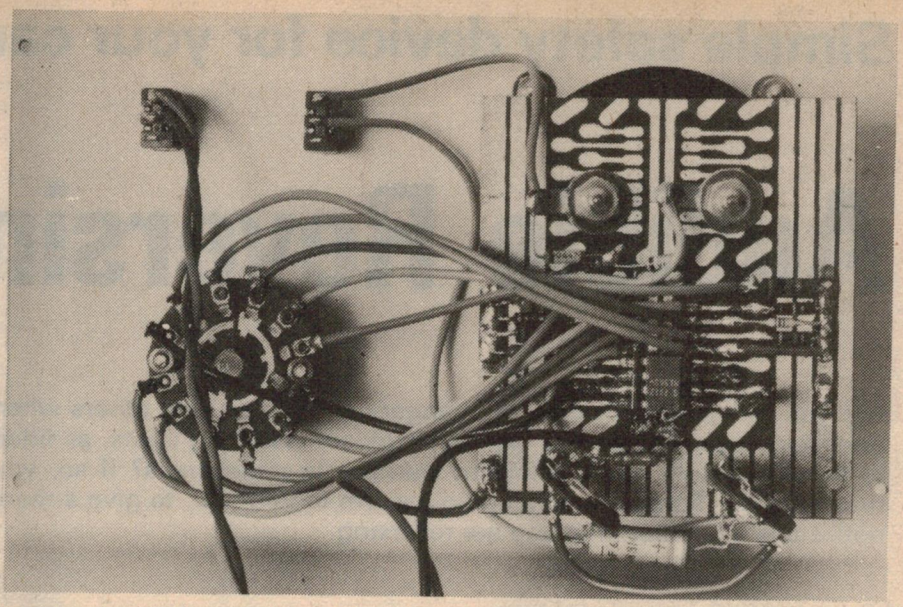
(PARK IN THE BOULEVARD)



Interior view of the prototype. Most of the components were mounted on a piece of general-purpose DIP PCB which, in turn, is bolted to the meter terminals.

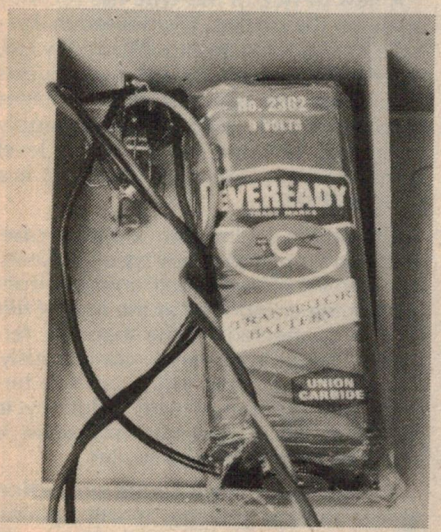
and the insulated terminal. This terminal is the common Jabel brand and is mounted through a ¼in diameter hole. The resulting error in our case is about 0.5pF.

It may be possible to improve this zero error somewhat by punching out a hole in the metal panel about ⅝in (16mm) in diameter and screwing a piece of insulating material over the hole. The terminal will then be mounted on the piece of insulation. We did not go to this trouble as we considered that the advantage gained was not really worth the extra effort.

As I said earlier, construction is not critical and it is left fairly open as to the way each individual tackles it. We used a piece of our general-purpose DIP PCB to mount the majority of components. All components, except the power supply, switches, meter and terminals, are mounted on the PCB. This may be seen in some detail in the photograph.

The 555 IC is mounted more or less centrally, with five of the oscillator resistors (including link) grouped on either side of the IC. The rest of the components are located around the IC. Interconnecting makes use of copper on the PCB where possible. Otherwise, links of some sort are used. In a number of cases, I drilled a hole through the board and the appropriate copper pad and then pushed a piece of 20B&S TC wire through the hole and made a link between points on the clear side of the board. This makes for a neat assembly.

To complete this assembly, I drilled two large holes so that the board could be mounted on the meter terminals. By the way, you may have noticed an extra resistor on the PCB assembly which could not be accounted for. Although I did not mention it earlier, I could not get a 1k trimpot in a hurry and so I settled for one of 470 ohms. The extra resistor is 330 ohms connected in series with the 470 ohm trimpot.



This view shows the simple power supply regulator mounted next to the battery. The necessary components are mounted on a piece of 5-tag strip.

Components for the power supply regulator, consisting of the transistor, zener diode, resistor and capacitor, were mounted on a 5-tag strip, with one mounting tag. This was located at the bottom of the case and adjacent to the battery.

The terminals, switches and meter may now be fixed to the panel and the PCB assembly may also be screwed to the meter. It now only remains to do the interconnecting wiring between the PCB, power supply, switches and terminals to complete the unit. You may have noticed that I have included two negative terminals. These are paralleled and they have been included so that capacitors with short leads may be accommodated readily, just as larger capacitors may be connected across the two outer terminals more conveniently.

If you should elect to operate the instrument from the mains, then it is quite an easy matter to dispense with the battery and substitute the transformer and electrolytic capacitor in its place. There is sufficient room for these components in the case which we used.

Having completed the wiring, it is always a good idea to make a thorough check to make sure that there are no errors or omissions. Satisfied that all is well, you are ready to switch on and calibrate the instrument.

To do the calibration, you need at least one capacitor of known value and close tolerance. Preferably, you should have five capacitors, such that when paralleled across the Cx terminals, you can check each of the five cardinal points on the meter. The lowest and the highest ranges could best be avoided for calibration, but any of the remaining three could be used.

I calibrated our unit on the middle range with five close tolerance .001uF polystyrene capacitors. These were added across the Cx terminals progressively and each of the relevant points checked and noted for any signs of non-linearity. The 47k trimpot is adjusted to give the most accurate readings across the meter scale.

If you only have one capacitor for calibration purposes, it should preferably be one which gives close to a full scale reading on the meter.

In addition to the basic calibration, we still have to calibrate the x10 multiplier. To do this, the range switch is set to the 0 to 0.5uF range. You will also need a capacitor of known value close to the maximum scale reading of 5uF. The 1k trimpot is set so that the reading on the meter scale corresponds with the value of the calibrating capacitor. The capacitance meter is now ready for use.

In using the capacitance meter, one precaution must always be taken. Before adding a capacitor to the Cx terminals, the range switch should be rotated to the extreme left or 0 to 0.5uF position. If this is not done and a large capacitor is connected to the terminals, the meter will be "slammed", which is a practice which should be avoided as much as possible.

A few minutes with the capacitance meter, with a handful of assorted capacitors, some electrolytics under 5uF, some diodes of various types, transistors, coaxial cable, etc., and you will soon appreciate how useful and versatile this little instrument can be.

Simple safety device for your car:

Audible Reversing Alarm

Are you worried about possible dangers to children and others when reversing your car? Do you feel that ordinary reversing lights, as fitted to most cars, are not a sufficient warning to pedestrians? If so, you may consider fitting an extra audible alarm to your car, to give a more noticeable indication that you are reversing.

by DAVID EDWARDS

First and foremost, readers and motorists should realise that when reversing their car, the onus is on them to avoid all collisions and dangerous situations. In particular, when crossing the footpath, pedestrians have right of way. This applies whether the car is reversing or moving forward normally.

As part of the design rules for Australian cars, all new cars must be fitted with visual reversing indicators. These can be either separate white lights, or the amber indicator lights. In either case, they must come on when reverse gear is selected, and the ignition is on.

This requirement has been in force for some time, so that the majority of cars now on the road are fitted with one or other of these warning systems. In general these systems are adequate, and do not require supplementing.

However, situations do exist when some form of additional indication is warranted. Perhaps the most obvious example is that of a car reversing from a garage across the footpath and onto the street. The possibility exists, especially in daylight, that pedestrians may not see the reversing lights, or hear the car itself.

In these situations, the car driver may not be able to see the pedestrians either, and so there is a chance that the pedestrian may be knocked down and injured. The fact that the driver was not able to see the pedestrian does not absolve him from blame; the law requires that he exercise the necessary care required to prevent such accidents.

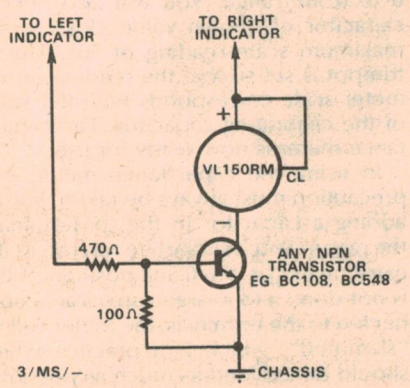
One possible solution to this problem is simply to reverse into the garage, rather than out of it. This means that when leaving the garage the driver will have much better vision, and that he has a clear, unobstructed view when reversing into the garage.

In some cases, however, this course of action is not practicable, and the car must be reversed from the garage. In these situations, a majority of pedestrians who realise that the car is about to reverse will yield right of way, even though they are not required to by law. The car driver must still be vigilant, however, as not all pedestrians may see and act upon the normal reversing light indications.

It is in these situations that it can be worthwhile to have an additional indication that the car is reversing. One quick and simple way of doing this is to operate the car horn briefly. This is a universal sound that is usually acted upon promptly by pedestrians.

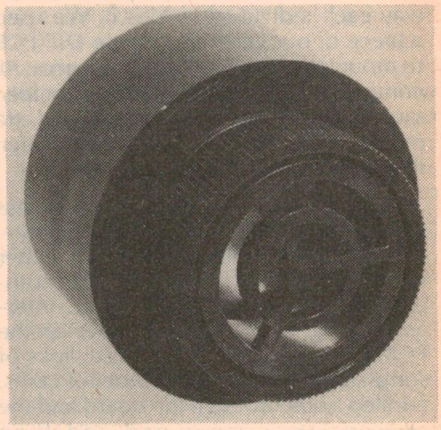
Blowing the horn does require conscious action from the driver, which may not always be carried out. In addition, car horns tend to produce extremely loud sounds, which may not be appreciated by those in the vicinity. What is really required is a softer sound which will operate automatically.

This can be done quite simply by wiring a suitable sound source in parallel with the reversing lights. Such a sound source should be cheap, robust and easy to fit. Completely solid state piezoelectric transducers fit this bill completely.



EA AUDIBLE REVERSING INDICATOR

Note that this circuit is suitable only for negative earth cars which use the indicator lights as reversing lights. See text for details on other types of cars.



Shown above is the solid state piezoelectric transducer, which forms the basis of the alarm. It can be connected for either pulsed or continuous operation.

A new device of this type has recently come on the market. Distributed in Australia by C & K Electronics (Aust). Pty Ltd, the AudioLarm VL150RM continuous tone/deep unit operates from voltages between 5 and 16VDC. With a supply voltage of 12V, the output sound level averages 92dB. Operating frequency is a nominal 2900Hz.

The unit is sealed into a plastic case, with two tin plated screw type terminals. A third control lead simply emerges from the potting compound at the rear. If this lead is connected to the negative terminal, the unit operates continuously. But if it is connected to the positive terminal, the unit beeps with a duty cycle of about 70%. Current consumption is less than 100mA in both modes.

The AudioLarm has diode protection against reverse polarity. It will operate over a temperature range of −20 to +65 degrees C. It will continue to operate even when submerged in water (we tried it!), and it cannot be damaged by sharp objects entering the grill. The unit is

mounted onto a panel from the rear, using a 28mm dia. hole and the supplied retaining rim.

The remaining problem then is simply how to connect the unit into the wiring system of your car. If your car is fitted with separate reversing lights, then all you have do is find the appropriate wire, and connect the AudioLarm between it and the car chassis, with appropriate polarity. If your car has a negative earth system, connect the negative lead from the unit to the chassis, and the positive and control leads to the wire.

For positive earth cars, simply reverse the leads from the AudioLarm. We should mention that the unit will only operate satisfactorily on 12V cars. With 6V systems, the sound produced is too low in intensity to be of use.

Cars which use the rear indicator lights for the reversing lights pose a slightly harder problem as far as interconnection is concerned. The AudioLarm could be connected across the reversing switch, but this would involve running additional wiring from the front of the car to the rear, where the unit is best mounted. If you feel capable of finding the switch, and sorting out which leads are the correct ones, as well as running the extra wires, go ahead by all means.

However by simply adding a single transistor it is still possible to keep all wiring in the boot area of the car. The circuit, which is shown in the diagram, functions as a simple AND gate. Any small general purpose NPN transistor can be used.

In order for the AudioLarm to be energised, both left and right indicators must be on. If either one is on alone, such as when the direction indicating system is in operation, the unit will not sound. If a disabling switch is required, it should be connected in parallel with the 100 ohm resistor. This will keep the switch contacts wetted, and ensure reliable operation.

If the car is fitted with a hazard warning system, the alarm will operate when this system is used. It will be pulsed on and off in sympathy with the hazard lights. If your car has a positive earth electrical system, use a PNP transistor, and reverse the connections to the alarm unit.

The transistor and associated components can be mounted on a small piece of tagstrip, and placed in any convenient position inside the boot. The alarm unit itself should be mounted in the vicinity of the rear bumper bar, facing downwards so as to minimise the chance of dirt or other foreign materials clogging the grill. Ideally it should be mounted so that it will not be struck by stones flung up by the road wheels, and so that it cannot be easily seen.

So there you are: a simple and easily installed audio alarm system, to supplement the normal reversing light indicators. Using a minimum of parts, it should be very reliable in operation.

Save on car service costs with the

Heathkit CM-1050 engine analyser

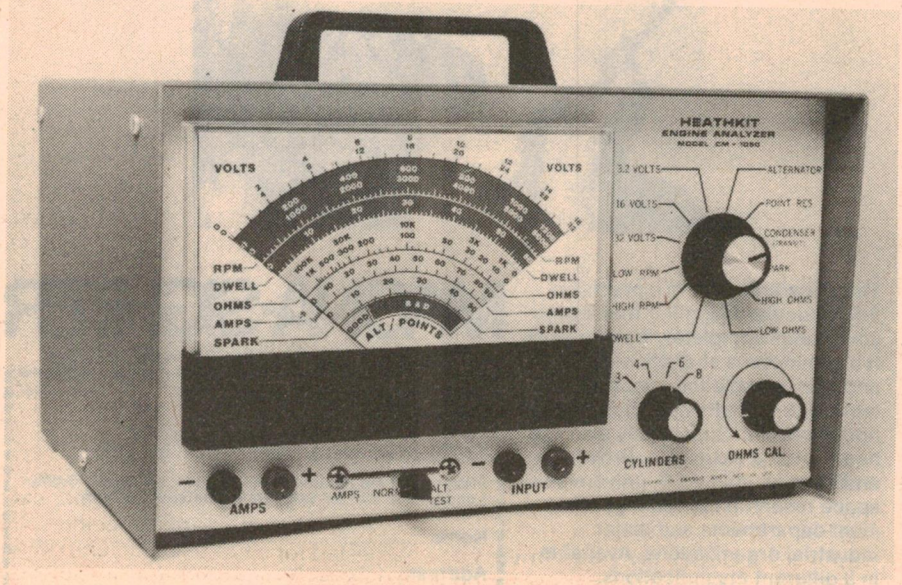
One of the most useful instruments that one can have for auto tune-up work is an engine analyser to enable correct adjustment of the carburettor and ignition system, and to check on battery, voltage regulator and alternator condition. This build-it-yourself engine analyser from Heathkit should meet the needs of both garages and Saturday-afternoon mechanics alike.

by GREG SWAIN

With the cost of petrol edging closer to the inevitable $1 per gallon mark, there is now more incentive than ever to keep the family car in a good state of engine tune. A well tuned engine will not only give better performance, but will also give reduced fuel consumption and save a few of those hard-earned dollars. And if you do your own tune-up work you can save on service costs as well.

There are many Saturday-afternoon mechanics who could take advantage of these potential savings—if only they had the right equipment. If you are one of these people, then this project from the Heath Company should really hit the spot. It is the Model CM-1050 Engine Analyser which, for an initial outlay of around the $118 mark, will enable you to maintain your car in a good state of tune, and save on service and fuel costs. It could well pay for itself in a very short time.

A glance at the specifications panel will give some indication of the capabilities of this versatile test instrument. Basically, the instrument is supplied as a kit of parts, complete to the last nut and bolt, and intended for assembly in the home using a minimum of tools. The aim is that the purchaser derive a deal of satisfaction from building up the kit, and on completion be rewarded with a useful piece of test gear.



A comprehensive range of measuring facilities makes the CM-1050 Engine Analyser an invaluable service tool for engine tune-ups and fault finding.

Facilities offered on the Model CM-1050 Engine Analyser include provision for measuring voltage, current, resistance, engine speed (rpm), dwell and spark (voltage comparison between plugs). The unit is supplied complete with test cables which are clipped to various points in the wiring, but most frequently to the distributor terminals.

There is provision also to measure the voltage across the closed stationary points. This voltage is interpreted as points resistance, and read off the meter scale as "good" or "bad". In addition, the unit may be used to substitute a capacitor (condenser in automotive terms) in place of the existing capacitor in the distributor to check on its condition, and to check alternator condition.

Voltage measurements are performed on one of three ranges calibrated 0-3.2V, 0-16V, and 0-32V. A special "battery adapter" consisting of a large 0.25 ohm 50W resistor and a shorting strap, enables charging voltage to be measured. The 0.25 ohm resistor is placed in series with the battery to isolate the battery from the regulator.

Current measurements call for the use of a special current shunt which, when connected in series with any circuit, allows current measurements as high as 90 amps to be made. Charging current may be measured by using the shunt in conjunction with the battery adapter.

All measurements are read off a large, easy-to-read 11cm x 15cm meter movement.

Perhaps the most useful measuring facilities on the Model CM-1050 engine analyser are the tacho and dwell ranges, at least as far as everyday tune-up work is concerned. A tachometer of known accuracy is essential for adjusting the idling speed. This is particularly the case for cars with automatic transmission.

For example, the idling speed of a typical 6-cylinder car with automatic transmission is generally somewhere in the vicinity of 600 rpm with the transmission in drive. If the idling speed is too

high, the car will tend to creep more than normal, and if it is too low the engine will run roughly, have a tendency to stall, and have higher than usual bearing wear.

Note that modern cars tend to have higher engine idling speeds than earlier models, this because engine idle mixture is leaned off (and the adjustment sealed) to meet anti-pollution requirements. Whatever model car you own, it is important that all engine adjustments and settings be made according to the manufacturers' specifications. Invest in a workshop manual if you don't have one.

Ignition timing adjustments also require the use of a tachometer. For example, the initial ignition timing advance on 1971-1973 Holden HQ 6-cylinder models is 5 degrees BTDC (before top dead centre) at 480 to 520 rpm. This engine speed is obtained with the vacuum line to the distributor diaphragm disconnected and plugged.

So a tachometer is a very useful aid to the home mechanic. The instrument described here actually has two tacho ranges, one calibrated 0-1200 rpm and the other 0-6000 rpm. The lower range is used for idling speed adjustment, while the higher range may be used if you have occasion to test the engine speed under road conditions or calibrate a permanently installed tachometer.

Although the high range is marked 0-6000 rpm, this should not be taken as a licence to run any engine up to 6000 rpm while in neutral. In fact this is quite likely to put a piston through the head, and that is a very expensive repair job indeed.

It is also necessary to adjust the dwell before making ignition timing adjustments. Dwell is the number of degrees the distributor cam rotates while the ignition points are closed. This measurement, also called "cam angle", affects timing. (Note, however, that timing does not affect the dwell.)

Before carrying out timing adjustments, therefore, the dwell angle should be set to the manufacturer's specified figure. For Holden 6-cylinder engines, this is given as 30-35 degrees. If the measured dwell is less than the specified figure, the point gap is too wide and must be decreased. On the other hand, if the measured dwell is too high, the gap is too narrow and must be increased.

There is another reason why proper dwell adjustment is important.

In the ignition system, the spark for ignition is generated when the distributor points, which are in the coil primary circuit, are opened and the magnetic field in the coil collapses. This collapse is very rapid and causes a high induced voltage in the secondary of the coil, firing the plug.

To prepare for the next spark, the distributor points must close and let the magnetic field build up again in the coil. This build-up of the magnetic field is not instantaneous, and if the distributor points do not remain closed for long enough it will not have time to build up to its maximum level. The result will be a low secondary voltage and a weak spark.

This phenomenon is particularly noticeable at high speed, and can cause misfiring. It can also make the engine harder to start, particularly in cold weather. For these reasons, it is necessary to allow the points to remain closed for as long as possible, and the manufacturer's recommendations should be followed when making adjustments.

A change in dwell angle reading or a wavering of the meter pointer can mean one or a combination of several faults. A fluttering pointer at high engine speeds can indicate points bounce. Increased tension on the moveable-point spring can correct this fault. If the meter pointer wavers, the distributor cam shaft could be wobbling due to worn bearings, or the cam could be worn.

The circuit details of the tacho and dwell ranges are described in some detail below. Other ranges, including voltage, current and resistance measurements, function in a manner similar to a conventional multimeter and are not detailed.

The main exception here is the capacitor test facility. As indicated previously, for this test the engine analyser simply switches a substitute capacitor in place of the existing capacitor in the distributor. Circuit details are given in the construction manual. The other exception is the spark test circuit, which is also detailed in the manual.

Fig. 1 shows a simplified schematic of the dwell circuit. When SW1 is in the dwell position, transistor Q1 acts as a switch to supply operating voltage to transistors Q2 and Q3. Transistor Q1, in turn, is controlled by diode D1.

When a voltage greater than 4.5V is present at the positive input, or the positive input is disconnected, diode D1 is reversed biased and no current can flow through resistors R18 and R19. This means that transistor Q1 is turned off, and no voltage is applied to Q2 and Q3.

However, if the inputs are shorted together, as when the ignition points close, current flows through R19, D1 and R18. This turns Q1 on and the internal battery voltage is applied to Q2 and Q3.

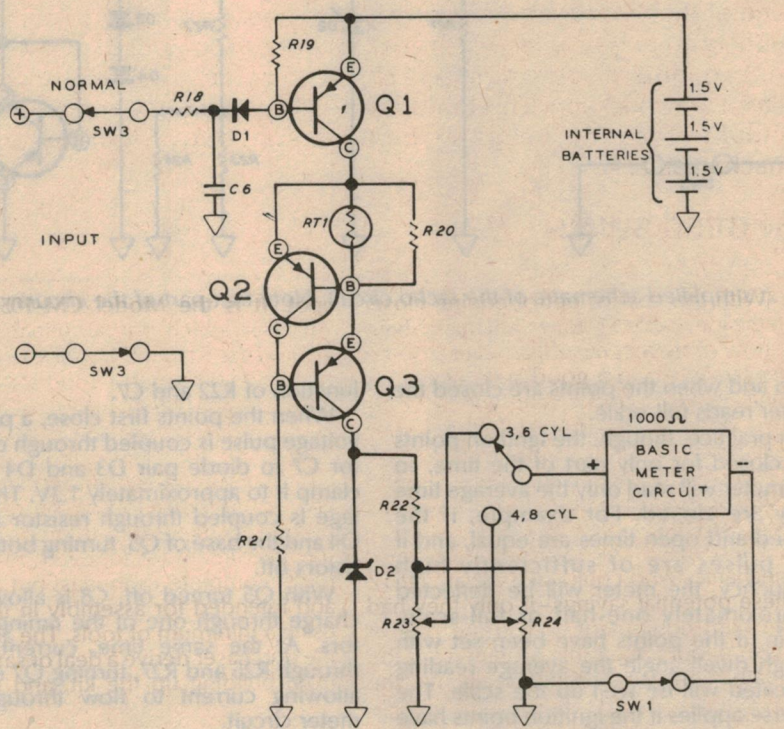


Fig. 1: simplified schematic of the dwell measuring circuit.

Capacitor C6 and resistor R18 remove large voltage spikes that occur when the ignition points open.

Resistors R20 and R21 provide bias voltage for Q2 and Q3. Q3 is a constant current source with voltage reference provided by the combined base-emitter drops of Q2 and Q3. The current from Q3 flows through zener diode D2, causing the zener reference voltage to be applied to the resistor network made up of R22, R23, and R24. Thermistor RT1 is used to compensate the circuit for temperature variations.

Voltage is applied through either R23 or R24 by SW2 to the basic meter circuit. With the inputs shorted together, R23 is adjusted for a full-scale meter reading of 60. R24 is adjusted for a "full-scale" meter reading of 45. Thus, when the ignition points are open, the meter reads

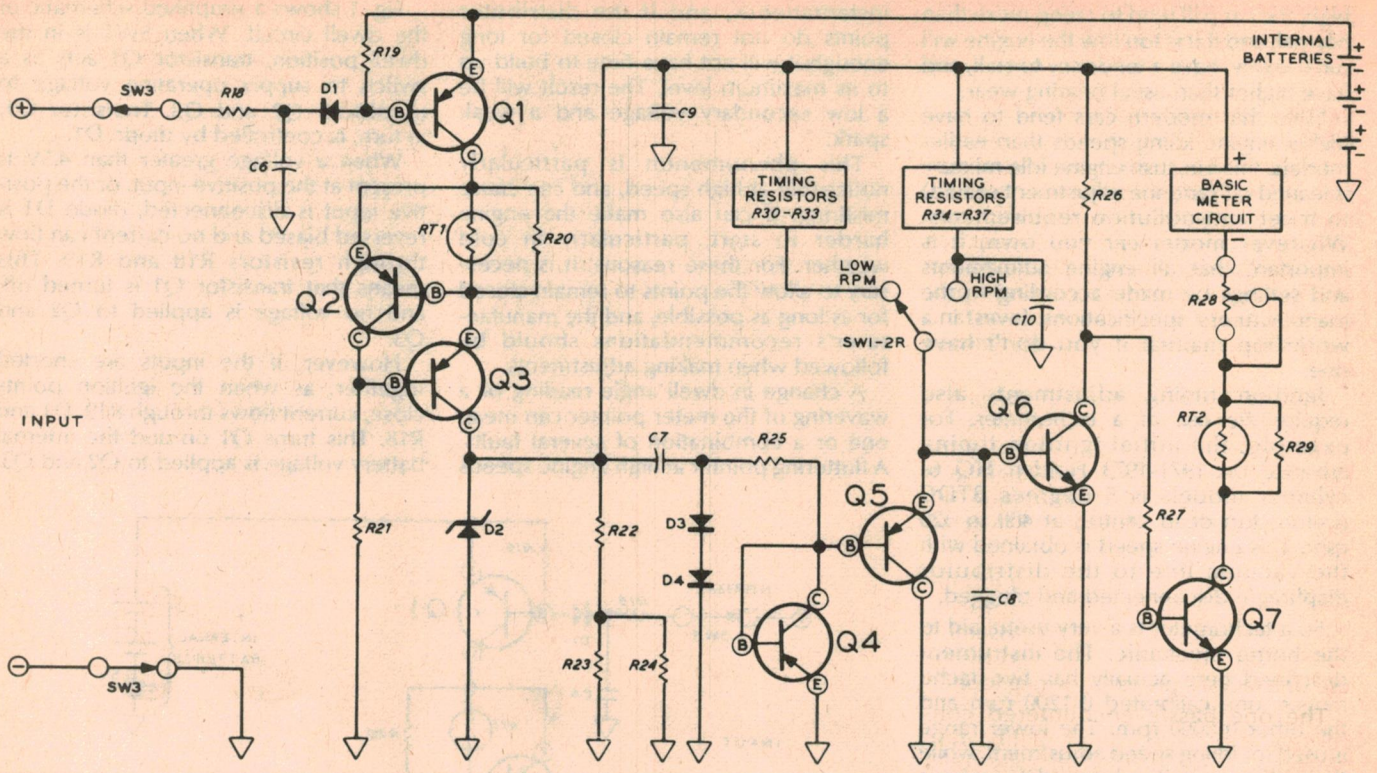


Fig. 2: simplified schematic of the tacho circuit. Note that part of the circuitry is common to the dwell circuit.

zero and when the points are closed the meter reads full-scale.

In practice, though, the ignition points are closed for only part of the time, so the meter will read only the average time they are closed. For example, if the closed and open times are equal, and if the pulses are of sufficiently high frequency, the meter will be deflected approximately one-half or full-scale. Again, if the points have been set with a high dwell angle the average reading indicated will be well up the scale. The reverse applies if the ignition points have been set with a small dwell angle.

We do have a specific criticism of the dwell circuit in that the design end-point voltage for the internal cells is somewhat on the high side. We checked the circuit using a variable supply and found that it ceased to function properly when the supply voltage fell below about 3.4V. This gives an end-point voltage for each cell of somewhere around 1.1V, and means that the cells will have to be replaced more frequently than otherwise.

Dwell angle is, by the way, independent of the engine speed. To understand why this is so, consider the fact that a given engine speed, say X rpm, will produce an average reading due to the open and closed times of the ignition points. Doubling the engine speed to 2X rpm doubles both the open and closed times, leaving the average reading unchanged. The dwell angle should thus remain constant for all engine speeds.

Fig. 2 shows a simplified schematic of the tachometer circuit. This circuit is identical to the dwell circuit as far as the junction of R22 and C7.

When the points first close, a positive voltage pulse is coupled through capacitor C7 to diode pair D3 and D4 which clamp it to approximately 1.3V. This voltage is coupled through resistor R25 to Q4 and the base of Q5, turning both transistors off.

With Q5 turned off, C8 is allowed to charge through one of the timing resistors. At the same time, current flows through R26 and R27, turning Q7 on and allowing current to flow through the meter circuit.

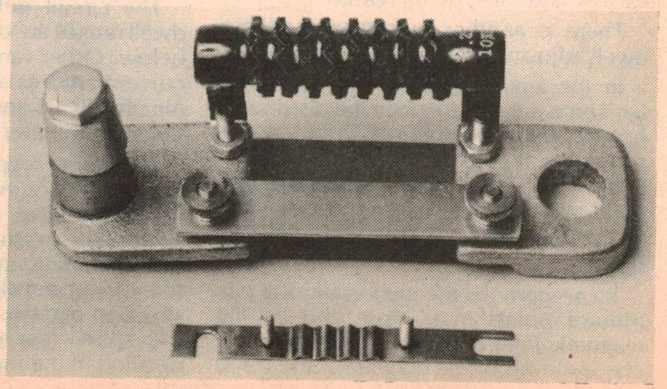
Before the ignition points open again, C8 becomes charged, Q6 conducts, and Q7 cuts off. This causes the meter to respond to only a small part of the pulse generated when the points close. The measured pulse duration is independent of engine speed, and is changed only by the selection of a different timing resistor.

When the points open, the voltage at D2 drops to zero. This causes Q4 to clamp a negative voltage on the base of Q5, turning Q5 on and providing a discharge path for capacitor C8. Capacitor C8 then discharges to zero volts, turning Q6 off. The circuit remains in this condition until the points close again.

Thus, each time the ignition points open and close, a current pulse flows through the meter circuit. The width of this pulse is determined by the charging rate of C8 through one of the timing resistors. The meter will indicate the average pulse rate.

Thermistor RT2 is used to compensate the circuit against temperature variations, while capacitor C9 prevents stray voltages from appearing across D2. Capacitor C10 is switched in parallel with C18 on the high rpm range to correct a slight error caused by the Q6-Q7 circuit at high engine speeds.

Now let's take a look at the Model CM-1050 Engine Analyser as a project for



This view shows details of the 0.25 ohm resistor assembly and the special 90A current shunt. The resistor is used to isolate the voltage regulator from the battery when charging voltage is to be measured.

the do-it-yourself enthusiast, that is as a kit of parts.

To summarise, the kit is presented with typical Heathkit thoroughness, carefully packaged, and accompanied by the customary detailed assembly manual. As with the exhaust analyser described last month it went together with few problems, worked right from switch-on, and was rugged and attractive in finished form.

From a physical standpoint, the unit is constructed in a simple U-shaped chassis with a blue marviplate cover. Most of the electronics is contained on a single PCB which is mounted vertically inside the chassis and held in place by the switches and the meter terminals.

The most involved part of the job has to do with the switch wiring. However, this is carefully detailed in the assembly manual, and is greatly simplified by the use of a factory-prepared wiring loom.

The one hassle encountered concerned the tachometer calibration procedure. This procedure calls for a 50/60Hz input from the mains, and a calibration cable with a two-pin plug is supplied for this purpose. A 10k 1W resistor in series with one of the leads completes the cable.

The problem is that the procedure assumes a mains voltage of 120VAC, and no provision is made for other voltages. There is a simple solution to the problem though—just solder a second 10k 1W resistor in series with the first and plug into the 240VAC 50Hz mains. The RPM CAL control is then adjusted so that the meter reads 1000 rpm.

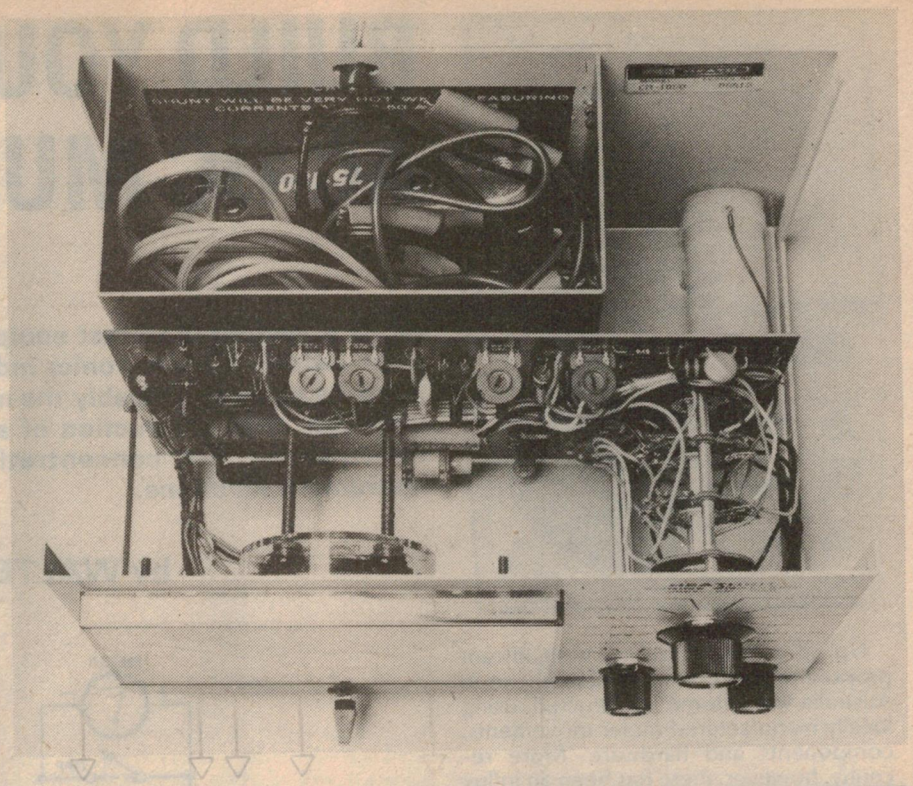
Although an American style two-pin mains plug is supplied as part of the calibration cable, it isn't really necessary that you replace it with an Australian-approved 3-pin type. It takes only a few seconds work to carry out the calibration procedure, after which the calibration cable is no longer used (except perhaps for occasional checks on tacho accuracy).

Exercise extreme caution when carrying out the calibration procedure to ensure personal safety. If you feel at all unsure of yourself, wind some insulation tape around the connections between the test leads and the calibration cable.

Operation of the completed instrument is described in a comprehensive handbook accompanying the kit. The procedure for obtaining each of the various measurements of which the instrument is capable is described in some detail, and the various electrical connections shown in pictorial form.

For those unlucky enough not to get the instrument going first try, the assembly manual contains a detailed section on troubleshooting procedures. In the event of further difficulties, advantage may be taken of the full technical back-up and factory repair service offered by the company.

The Heath Company is represented in Australia by Warburton Franki Pty Ltd, who have branch offices in all state capitals and in Wellington NZ. Readers should either write to The Heath Centre, 220 Park St, South Melbourne, Vic 3205, or ring one of the following numbers: Sydney 648 1711, Melbourne 699 4999, Brisbane 52 7255, Adelaide 356 7333, Perth 65 7000, Hobart 23 1841, Wellington (NZ) 69 8272.



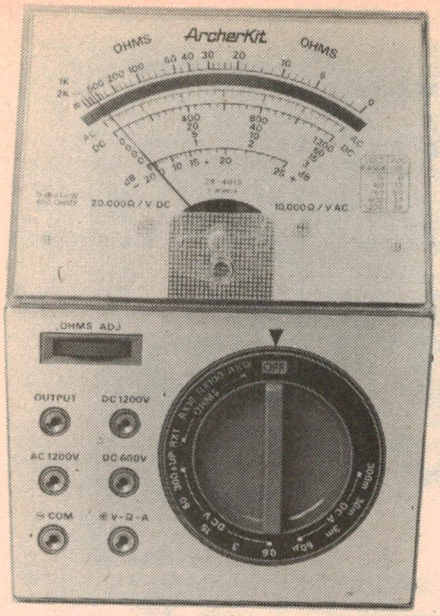
SPECIFICATIONS

ELECTRICAL

Voltmeter	Three ranges: 0-3.2 volts DC, ±3% of full scale. 0-16 volts DC, ±3% of full scale. 0-32 volts DC, ±3% of full scale.
Ohmmeter	Two ranges: R x 1 (100 ohm centre scale) ±3° arc. R x 100 (10k ohm centre scale), ±3° arc.
Tachometer	Two ranges: 0-1200 rpm, ±3%of full scale. 0-6000 rpm, ±3% of full scale.
Dwell Meter*	Two ranges: 0-45° (on 0-60° scale), ±3% of full scale. 0-60, ±3% of full scale.
Amperes	−5 to +90 amperes DC, ±3% of full scale.
Spark Output	0-50
Point Resistance	Good/Bad.
Alternator	Good/Bad.
Condenser	0.22 µF, 10%.

GENERAL

Cables Supplied	Two 2.4m two-conductor test cables. One 60 cm alligator lead. One 60 cm alligator to push-on connector.
Accessories Supplied	90-ampere shunt. 0.25 ohm resistor assembly.
Batteries Required	Three 1.5V C-cells.
Battery Life	100 hours average.
Dimensions (overall approx.)	27 cm wide x 19 cm high x 22 cm deep.



BUILD YOUR OWN AC-DC MULTIMETER

While a vast array of test equipment is currently being sold—and used—within the electronics industry, the ordinary multimeter still holds its place as probably the most useful single item. This article discusses the construction of a typical bench multimeter from a do-it-yourself kit, concentrating particularly on how such an instrument functions.

by WALTER NEVILLE

Up till a few years ago, a significant proportion of the multimeters in use in Australia were home constructed, using locally manufactured meter movements, components and hardware. More recently, however, there has been an influx of multimeters, mainly from Asian countries, of such a quality and at such a price level that locally assembled instruments have not been able to compete.

That position still holds and is not likely to change in the foreseeable future, so that anyone who aspires to build up their own multimeter may as well forget the idea or else settle for a wholly imported kit, which can be expected to be price competitive.

But why build your own multimeter when a complete, commercial instrument can be bought for a comparable figure? The answer simply is that plenty of enthusiasts like to build things, partly for the satisfaction of doing so, and partly because the practical experience reinforces their appreciation of how the various gadgets actually work.

The multimeter pictured in this article was put together by the writer from an imported multitester kit branded as "Archerkit" No 28-4013 and sold by Tandy Electronics stores throughout Australia. The advertised price is $19.95 and compares with a figure of $24.95 for the same instrument fully built-up. Since the kit contains a detailed how-to-build-it brochure, the emphasis of our remarks here will be on how a multimeter works.

A "multimeter" or "multitester" normally contains a single moving coil or "D'Arsonval" meter movement with associated circuitry and calibration which allows it to read voltage, current and resistance appropriate to the needs of anyone involved in electronics—from engineer to enthusiast. This being the case, such instruments are sometimes referred to as "volt-ohm-milliammeters", or "VOMs".

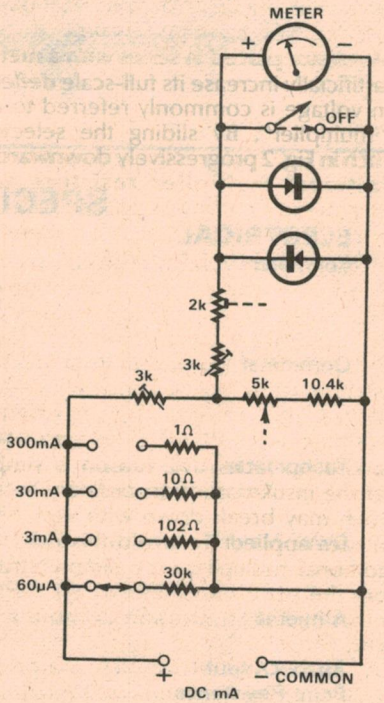


Fig. 1: Illustrating the circuitry in use when the instrument is set to measure direct current in milliamps.

The Archerkit 28-4013 is fairly typical in that it measures volts up to 1200DC and 1200AC, current up to 300 milliamperes and resistance up to about 2 megohms. It has an "off' switch position to minimise the effects of vibration while the meter is being carried and electrical protection to reduce the hazards of accidental overload.

To illustrate what is involved in this particular (and fairly typical) multitester, we have separated out the various functions, beginning with Fig. 1, which shows that part of the circuitry which is involved in the measurement of current. Some of the components shown have more to do with the other functions but, inasmuch as they are in circuit at all times, they have been shown with their values as marked in the manufacturer's main circuit diagram.

The basic meter movement is marked 2k 0-37, which can be taken to mean that it has an internal coil resistance of 2000 ohms and a sensitivity such that the pointer would traverse the full scale with a current through the meter of 37 microamps DC.

When the main selector switch on the front of the multitester is in the "off" position, it places a short-circuit directly across the meter, as indicated in Fig. 1. Thus shorted, the meter is electrically damped and there is much less tendency for the pointer to sway to and fro as the meter is carried about. As a precaution, users should develop the habit of switching the meter to "off" when not in use.

It will also be noted that the meter is shunted by a pair of silicon diodes connected in opposite polarity. In normal circumstances, these do not conduct, since the voltage across the meter, even at full scale, is not more than 74uV (ie, 37uA through 2000 ohms)—this being well below the turn-on voltage of the diodes. However, if the current through the meter should accidentally be increased, the voltage across it will increase and, at a certain point, one or other of the diodes will turn on, thereby absorbing some of the excess current. This diode protection scheme will not stop a meter pointer from being slammed over hard by accidental overload, but it can often prevent irreversible damage to the mechanism or an actual burn-out of the very fine wire comprising the moving coil.

If the external "+" and "-" tip jacks and leads were run directly and only to the meter movement, it would be possible to have the meter measure currents up to a full-scale figure of 37 microamps.

In fact, the network of resistors in parallel and series with the meter movement reduces its sensitivity so that, with the side switch in the bottom position as drawn, the effective sensitivity is 60 microamps full scale—with 37uA flowing through the meter and 23uA through the resistive network.

There are at least two reasons for arranging things this way. One is convenience, in that part of the resistive network can be made adjustable (in this case the upper 3k resistor) so that the sensitivity can be adjusted precisely to 60uA, taking account of slight differences in the meter movement. This is one of the preset adjustments in the particular kit.

The second reason is that, by choosing a figure like 60, the meter scale can be divided up logically into segments of conveniently related whole numbers: 3, 6, 12, 15, etc, thus simplifying the job of laying out and interpreting the scales on the meter face.

When the slider is moved up one position, from "60uA" to "3mA", most of the current flows directly between the external "+" and "–" connections through the 102 ohms resistor. But why an odd value like 102 ohms? The answer simply is that,

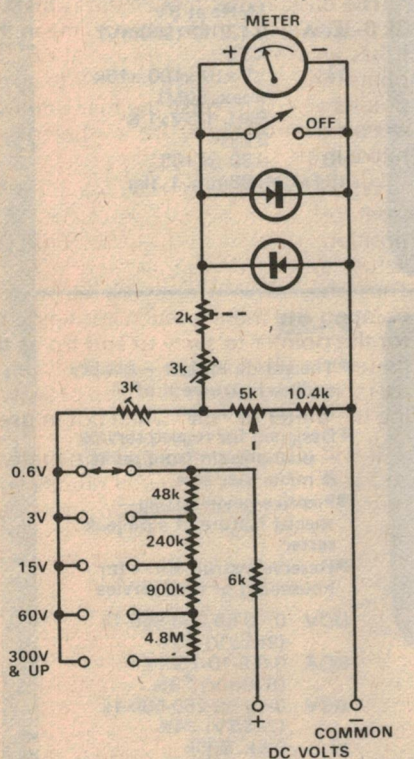


Fig. 2: To measure volts, "multiplier" resistors are introduced in series with the meter.

with this particular value shunted across the meter circuit, the current divides proportionately with, say, 37uA flowing through the meter and 2.963mA through the 102 ohm "shunt" resistor. Since this relationship is fixed while ever the instrument is set to this position, the meter face can be marked and read just as if the movement was, in fact, reacting to current from 0 to 3 milliamps full scale.

By using lower value shunts (10 ohms and 1 ohm) a greater proportion of the current to be measured passes through these shunts allowing the meter to be calibrated and read as if it were indicating 0 to 30mA full scale, and 0 to 300mA full scale. Other multitesters may use different ranges or more ranges but the principle remains the same.

Fig. 2 shows the configuration of the circuit when the multitester is switched to measure DC volts. With the slider in the topmost position, as drawn, a 6k fixed resistor and a 3k adjustable is introduced between the external "+" terminal and the rest of the metering circuit. Why these values? Because, with 0.6V applied between the external "+" and "–" test connections, the current through the meter can be adjusted so that it will read exactly full scale. In other words, a meter which as we saw would deflect fully with about 74uV across its terminals is made to behave as though it needed 0.6V for full deflection.

A resistor placed in series with a meter to artificially increase its full-scale deflection voltage is commonly referred to as a "multiplier". By sliding the selector switch in Fig. 2 progressively downwards, additional multiplier resistors are brought into circuit (48k, 240k &c) allowing the meter to function as a voltmeter reading 0-3V, 0-15V, 0-60V, &c.

Note that the final position shows "300V & Up". On the actual multitester, it is possible to measure 600V and 1200V—but not by further rotating the switch. Instead, the switch is left at the "300V & Up" position and the external lead plugged into other appropriately marked tip jacks. The reason is simply that the insulation of an ordinary rotary switch may break down with very high voltages applied. To avoid this risk, the additional multipliers are simply strung from the extra test points to the switch so that it is never stressed by more than 300V.

As a point of interest, if one looks at the 300V range, the amount of multiplier resistance in circuit is approaching 6,000,000 ohms. If one divides this figure by 300 the result is 20,000. From this comes the maker's specification of the instrument as 20,000 ohms/volt DC indicating the amount of loading which the meter imposes, as a voltmeter, upon the circuit under test. The above figure and the further specification of 10,000 ohms/volt AC are average and typical, these days, although some multitesters have an even higher specification. Old fashioned multitesters, with an internal resistance of 1000 ohms/volt or lower are no longer favoured because they load circuits under test unnecessarily.

To measure AC volts, special provision has to be made, because an ordinary moving coil meter movement will respond only to DC through the coil. The standard approach is to pass the alternating current entering the metering circuit through a rectifier system, which changes it into DC, to operate the meter. By careful choice of circuitry and components, the pointer deflection caused by the resultant DC can be read off in terms of the AC voltage applied to the external test points.

Thus, an AC voltage applied to the external terminals of Fig. 3 will cause a

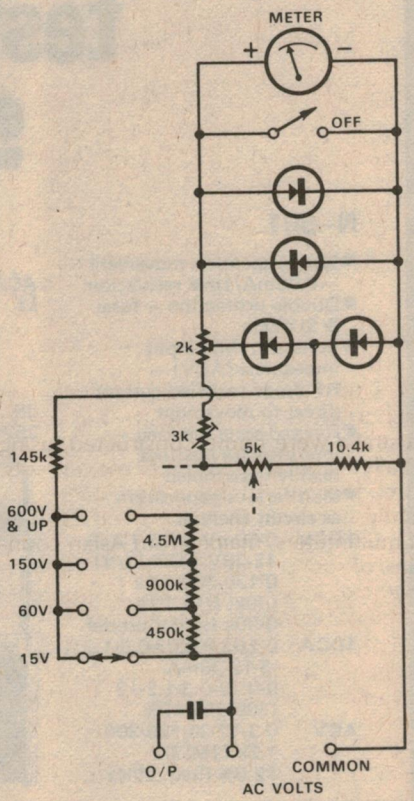


Fig. 3: To measure AC volts, rectifiers are necessary in addition to multipliers.

current to flow through one or more multiplier resistors to the junction point of two diodes. Here the current is rectified and fed as DC to the meter terminals via a 2k adjustable potentiometer. With the values and switch setting shown in Fig. 2, 15V AC rms applied to the external terminals can cause the meter to deflect to full scale. In short, it can be calibrated and read as a 0-15V AC voltmeter.

By introducing additional resistors (450k, 900k, 4.5M) the meter can be made to read 0-60V AC, 0-150V AC, 0-600V AC, and 0-1200V AC using an additional tip jack.

As a normal extension of the AC voltage function, most multitesters include an extra tip jack connection marked "Output" or "O/P". This is tied to the active AC terminal by a series capacitor, which will have the capability of blocking any DC voltage, while passing AC voltage to the metering circuit. The test leads may thus be connected to the plate of an output valve, or the collector or emitter of a transistor stage and will respond only to the amplitude of any AC signal present, ignoring the DC supply voltage.

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±DCA 0-2μS 0-0.03-0.3-1.2-3-12-30mA 0-0.12-0.3-1.2-12 (300mV) ±2%
ACV 0-3-12-30-120-300-1.2k (1MΩ) ±2.5% Freq. 20Hz to 50kHz (±1dB)
ACA 0-1.2-12A
Ω x1 x10 x100 x1k x10k x100k (max. 200M) Batt. 1.5Vx1 & 9Vx1
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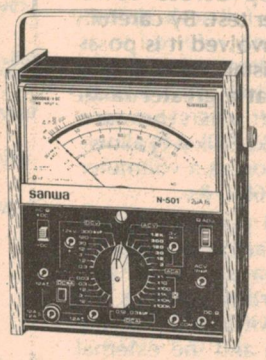

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- **Measurement ranges available.**

DCV 0.1 0.5 2.5 10 50 250 1000 (20kΩ/V) (25kV w/HV probe extra)
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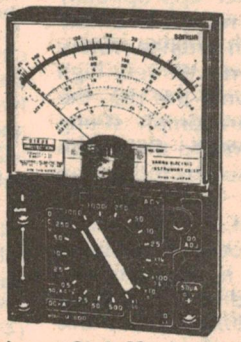
LI 0.06mA 0.6mA
LV 3V 3V



LI 6mA 60mA
LV 3V 3V

- **Allowance.** Within ±3% f.s.d. for DCV & DCmA Within ±4% f.s.d. (±6% for 2.5V) for ACV Within ±3% of scale length for Ω
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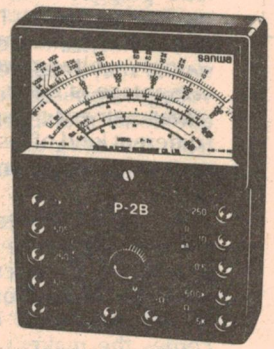

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MULTIMETER-continued

mention in regard to the AC voltage scales. Typical rectifiers are not precisely linear, in that the DC out is not exactly proportional to the AC in. It is therefore not unusual to find a scale for the AC voltage ranges separate from that for the DC ranges. Somtimes a special scale is provided only for one or two of the lower voltage AC ranges, common practice being to use red printing to distinguish them. The important point is to be aware of the possibility and to make sure to read the scale intended by the manufacturer.

Fig. 4 shows the configuration of the metering circuit when switched to measure the resistance in ohms of any circuit or component introduced between the test points. In this case, a single 1.5V cell is introduced between the active external connection and the rest of the metering circuitry.

As the circuit stands, with no electrical connection between the two external

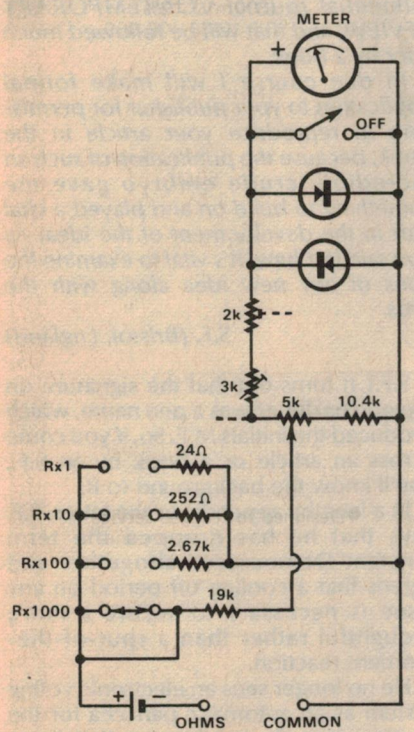


Fig. 4: For resistance measurement, the circuit is different again, involving a battery.

test points, no current flows through the meter and the pointer remains in its at rest position. In terms of the ohms scale, it can be said to be indicating "open circuit".

Conversely, if a direct short is placed between the two external test points "common" and "ohms", current will flow through the 19k resistor into the network associated with the meter, thence through the meter itself, causing the pointer to deflect. The purpose of choosing the values shown is to make it possible, by adjusting the 5k potentiometer, to make the pointer read exactly full scale. Thus, full scale deflection signifies a short circuit between the test points. If different values of resistance are now introduced between the test points—i.e., something between open-circuit and short-circuit—the pointer will take up some intermediate position. By suitable calibration, the resistance can be read straight off the ohms scale.

Because the voltage delivered by a typical cell is likely to vary somewhat during its useful life, it is normal to make the "Ohms Adjust" potentiometer accessible on the panel of multitester. Each time the ohms scale is used, the test prods should be touched together and the potentiometer reset, if necessary, to bring the short-circuit condition to exact full scale.

A problem of virtually all multitester ohms ranges is that the highest and the lowest values are rather difficult to read accurately to any one scale. It is common practice, therefore, to introduce additional resistors, as shown in Fig. 4, which serve to increase the current through—and the voltage drop across—lower values of resistor under test. By carefully choosing the values involved it is possible to modify the resistance calibration by factors of 10 so that a greater range of values can be read within the more meaningful centre portion of the resistance calibration.

While the use of shunts can extend the usefulness of the ohms ranges downwards into lower values—important with transistor circuitry—values under test above about 0.5 megohm cause only a very tiny deflection on even the most sensitive scale and therefore cannot be read at all accurately.

Some multitesters gain a small advantage by using a somewhat higher internal supply voltage to start with but the advantage is quite limited. For accurate measurement of high resistance values a different kind of instrument is desirable.

So, there you have it—the workings of a traditional (yet up-to-date) multitester. If it merely clarifies the type of instrument for you for the first time, the article will have served a purpose. If it motivates you to study, to understand and to build one for yourself, so much the better.

Forum

Conducted by Neville Williams

A further look at "Instant Democracy".

Those who have been regular readers of these columns may recall discussion, in February 1975, under the heading "Out with the ballot boxes. In with what?". After some debate in subsequent issues, the subject dropped out of sight — until just recently, when we had a letter of acknowledgement and thanks from the original correspondent.

What started it all was a letter from a reader M.F., then resident at Glenroy, Victoria, who lamented that conventional procedures for conducting elections, referenda and opinion polls were hopelessly inefficient and protracted when viewed against what would now be possible using modern technology. He felt that they could be up-dated to advantage, but nobody seemed interested in publishing his ideas.

Briefly, he proposed setting up booths throughout the nation in which members of the public could register votes or opinions by electronic means. The resulting data would be validated, classified and summed in centralised computer installations. People eligible to vote would use an individual voting card with a magnetically recorded number but the centralised equipment, while reacting to both identification and vote, would not correlate the two, so that secrecy could be preserved.

Because it would be possible to obtain a very short-term public reaction to questions of major importance, a union ballot on an impending strike, shareholders' opinion on company policy, etc., the system might conceivably be called "E.I.D.", short for Electronic Instant Democracy. Rather more conservatively, it might be dubbed "E.V.C." for Electronic Vote Collecting.

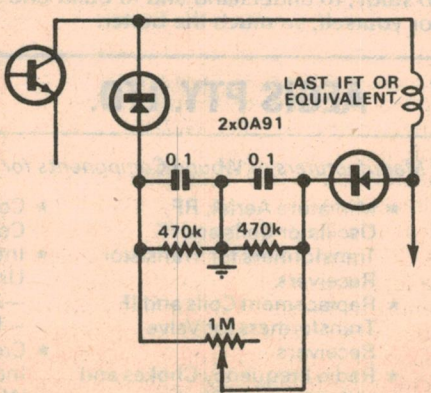
Commenting on this proposal, which was put to us at considerable length, we suggested that one reason why he had not been able to secure coverage in newspapers and magazines was his excessive enthusiasm for the proposition and his virtual dismissal of obvious and very practical problems: keeping cards, rather than rolls up to date; the liability of cards to loss, falsification and duplication; the possibility of "rigging" a computer program; the chance of the computer being made to print out the identity of people voting in a particular way; the strong chance that many groups would not accept individual secret voting.

But, in addition, we suggested that snap polls would not necessarily be in the public interest because what M.F. fondly referred to as "Instant Democracy" might be described more appropriately as "spur-of-the-moment democracy". There could well be merit in the existing voting system which, by its very nature, gives people time to think, and to consider long-term as well as short-term effects.

Events in Australia since that was written have emphasised just how vulnerable all Governments are in mid term when they are involved in an unpopular strategy intended (allegedly, anyway) to produce a result which will be seen, in longer term, to produce a commendable end result.

In short, a voting or opinion system which is too easily invoked could militate against long term planning.

The discussion prompted a good deal of personal comment and one letter, which we published in the June issue,



Suggested by Ian Pogson in the March 1976 issue, this simple noise limiting circuit may be of some assistance in remote areas.

sought to "take us apart" for being negative and critical – despite the fact that we were the one magazine which had published M.F.'s proposals. And also despite the fact that we commended the correspondent for his statement of a problem, and his desire to be constructive, ending with the suggestion "back to the drawing board".

As it transpired, M.F., who is now resident in England, followed our advice, as the following excerpt will show:

Dear Mr Williams:

Thank you very much for giving so much space to my idea in EA 2/75: Since then I've been following the reaction with much interest and your readers may be interested in the latest developments.

I have indeed gone "back to the drawing board" and have come up with an updated system that takes account of your criticisms and is much more practical. Indeed, the privately-circulated updated version has aroused enough interest in certain quarters in Britain to secure its publication later this year in the influential journal CONTEMPORARY REVIEW, and that will be followed much later by a book.

In due course I will make formal application to your publisher for permission to reproduce your article in the book, because the publication of such an incredibly crude embryo gave me something to build on and played a vital part in the development of the idea. As you said last June, it's vital to examine the cons of any new idea along with the pros.

S.F. (Bristol, England)

S.F.? It turns out that the signature on the original letter was a pen name, which produced the initials M.F. So, if you come across an article or a book by an S.F., you'll know the background to it.

In a lengthy appendix to the letter, S.F. says that he has dropped the term "Instant Democracy" altogether and agrees that a cooling off period on any issue is necessary to secure a more thoughtful rather than a spur-of-the-moment reaction.

He no longer sees an electronic voting system as an automatic panacea for the community's ills, but he says that living in Britain has convinced him more than ever that the community needs a more effective voice in all levels of Government. With one Parliament for 55 million people, "the legislative process has the reactions of a dinosaur when it needs the reactions of a shrew".

Having looked at the matters of accuracy, "rigging" and security, S.F. is convinced that they would not present a problem provided scrutineers were chosen for their understanding of the technology, rather than for their present ability to count pieces of paper. A record of votes cast could be kept by equipping each booth with a paper tape and punching mechanism.

Technology shock ... the problem of people faced for the first time with buttons instead of voting slips? People are becoming daily more accustomed to electronic presentations, as witness the current developments in Britain where all kinds of print-out information may soon appear on individual television screens by pushing a button on the "Viewdata" attachment.

And cost? Would it be any more than 100 miles or more of new expressway?

S.F. has a lot more to say, complete with quotes, all aimed at establishing the idea that his idea is not merely for a more efficient method of: "electronic vote collecting". It's for a system which will give the "silent majority" a new initiative in influencing the governmental "dinosaur".

In fact, S.F. seems quite sold on this word "initiative" and I tip that it will figure large in his future writings.

To change the subject completely, I would like to refer to a letter from a reader who must surely qualify as an inhabitant of that area described by such Australianisms as "back o' beyond" or "out past the black stump". While this may not be strictly true of Cobar in regard to everyday comforts, it would certainly seem to apply as far as radio reception is concerned.

Dear Sir,

The area in which I live is serviced by a sole ABC relay station located some 70 miles away (2BY, Byrock). While one learns to live with "Blue Hills", etc, one often yearns to hear sounds from the "big smoke".

Alas, even at night when reception is possible, the fading and inter-station interference makes the position rather dismal.

I was wondering if you could come up with a project for a "we of the never never" type of receiver, or, alternatively, a few hints and ideas on how to improve reception by such means as:

(a) active aerials;

(b) filters to remove such noise as from reticulation transformers, the neighbour's welder and other electrical devices;

(c) a clipping device to reduce the effects of lightning peaks;

(d) reducing the bandwidth to reduce interference from stations on closely allocated frequencies.

Before closing, may I compliment you on the excellent magazine you produce, and which I have enjoyed reading for some years now. Indeed, your magazine must be good, to judge by the number of people who beg, borrow or flog it off my desk every month!

C.K. (Cobar, NSW)

We certainly appreciate the "bouquet" but the last sentence does tend to make us weep silently in the corner. Surveys have shown that our regular readership is well over 200,000. If only they would all buy their own copy!

But, getting down to the substance of C.K.'s letter, it is indeed sobering to realise that, in this day and age, the options of some listeners are so limited. What with national, commercial, ethnic, FM and other nearby stations, listeners in Sydney can take their pick of about 14 "local" radio programs and at least 4 television programs. How we'd react if this were suddenly cut down to one vulnerable signal from a national regional 70 miles away!

Curiously, C.K. doesn't mention shortwave reception, to which I personally have turned on occasions, when marooned in a radio desert.

As for his request for assistance, I doubt that there is much chance of us attempting the design and description of a specialised build-it-yourself receiver, at least in the immediate future. These days, the construction of receivers in Australia, and the provision of components for same is just about at a standstill.

As for modifying an existing receiver, we hesitate to encourage readers to dive into commercial equipment, with iron a'smoking, in case they get into troubles outside the manufacturer's willingness to rectify.

It may be possible, for example, to sharpen up the selectivity by doctoring the IF channel wiring to nudge it closer to the point of oscillation, but it's a pretty dicey nudge. Say no more!

On the subject of noise limiters, a simple circuit that could perhaps be tried in many existing receivers was shown on page 89 of our March 1976 issue and a copy of the circuit is reproduced herewith. It may help with those isolated static crashes, although probably not with recurrent buzzing type electrical interference.

On this point, I am not very optimistic about beating electrical interference at the receiver, by the use of a mains filter, as suggested. My experience suggests that the only effective place for a mains filter is at the noise source, to prevent the hash getting into the mains. Once it does so, it tends to be radiated and to become just another radio signal, to be picked up along with the wanted station. The problem is that in a population centre well away from radio stations, the total noise ambient is produced by any number of fluorescent lights, switches and appliances, TV receivers, leaky line insulators, etc – and it just isn't possible to track them all down and treat them individually.

A clue as to the possible effectiveness of a local line filter can be obtained by listening at the site with a battery operated receiver connected to the proposed aerial and earth. If it suffers less from electrical hash than one powered from the mains, a local line filter may just help.

The only other thing I can suggest is that C.K. experiment with the old idea of

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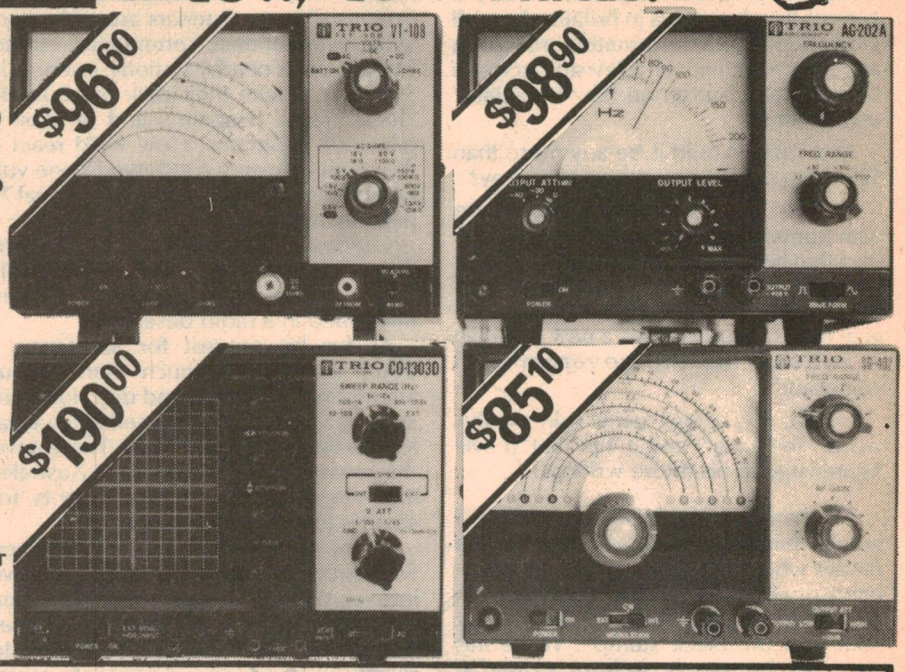

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Horiz. sensitivity:	300V (DC+AC peak) or 600V P-P
Attenuator:	500mV/cm
Freq. response:	DC to 250kHz
Input R&C:	1 Mohm, 40pF
Sweep freq:	10Hz to 100kHz in 4 ranges
Synchronization:	Internal (~)
Power requirements:	100/117/230V AC 50/60Hz

CAT Q-1230 ..... $190.00 tax inc. $167.00 tax free.

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Freq. range:	100kHz to 30 MHz in 6 ranges
Freq. accuracy:	±1%
Output voltage:	0.1V
Attenuator:	HIGH/LOW (10:1) and variable control
Modulation:	
Internal:	400Hz, 40% mod. degree
External:	Requires 1.5V RMS for 40% mod deg.
Power requirements:	100/117/230V AC 50/60Hz 6W
Dimensions: (mm)	189W x 131H x 220D (190W x 154H x 245D max dim.)
Weight:	2.5kg

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VT108 FET Volt-Ohm-Meter

DC Voltmeter:	0.5 to 1500V in 8 ranges
Input impedance:	11 Mohms on each range
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AC Voltmeter:	1.5 to 1500V RMS full scale
(dB)	−15 to +66dBm
(Any other voltage):	4.2 to 4200V P-P
Input impedance:	1 Mohm 80pF at 500-1500V range
Accuracy:	±5% at full scale
Freq. response:	15Hz to 5MHz ±10% 30Hz to 2MHz ±3%
Ohm meter:	0.1 ohm to 1000Mohm in 7 ranges
Accuracy	5% of setting range at scale 0.3-3 10% of setting range at scale 0.1-10
Memory 1% scale variation	Approx 30 seconds

CAT Q-1210 ..... $96.60 tax inc. $84.00 tax free.

AG202A Audio Generator

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Frequency accuracy:	±(3% +2Hz)
Sine wave characteristics:	
Output voltage	10V RMS ±10%
Distortion:	0.5% at 50Hz-100kHz
Square wave characteristics:	
Output voltage:	10V P-P
Overshoot:	3%
Sag:	10% at 20kHz
Output impedance:	600 ohms
Output attenuation:	HIGH/LOW (40dB) & variable
Drift with supply voltage (10% variation):	Frequency ±0.5% Level ±0.5dB
External synchronization:	
Sync voltage:	1%/V approx
Max input voltage:	3V RMS
Input impedance:	10kohm

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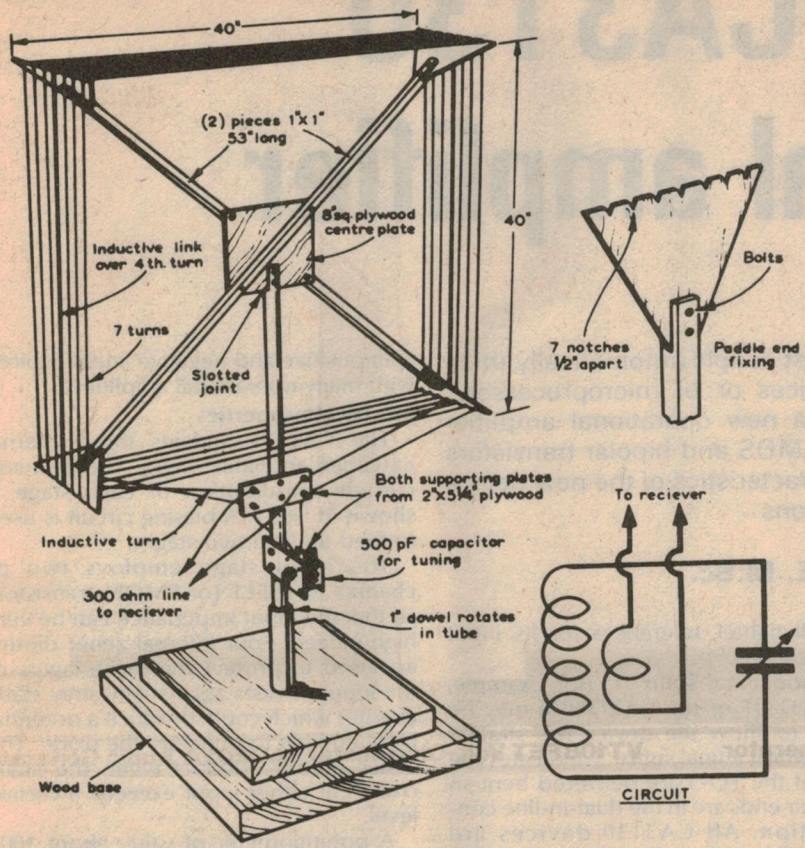
LOOP AERIAL REDUCES INTERFERENCE



Listeners wishing to receive broadcast band signals (52kHz to 1600kHz) in remote or difficult locations might well consider the loop aerial illustrated.

This type of antenna is directional; maximum pick-up is along the plane of the windings, minimum pick-up along a line at right angles to the windings. The depth of the null (degree of signal suppression) depends on the electrical balance of the windings so it is important that they should be symmetrical.

The loop is very simple to use. Tune in a station on the receiver, peak it with the loop tuning control and rotate the loop to optimum reception. Frequently it is possible to null-out different stations on the same frequency, where these are located roughly at right angles to each other from the point of reception.

Similarly, static from summer thunderstorms may often be minimised when listening to stations at right angles to the direction of the storm.

The 40in loop is a compromise between pick-up and convenience. A larger loop will have greater pick-up. Alternative sizes can be constructed, using approx 100ft of plastic covered wire of about 22SWG for the main winding which should be wound to a whole number of turns. If the loop will not tune to the HF end of the band there are too many turns. If it will not tune to the LF end then add turns or increase the value of the tuning capacitor. The pick-up loop consists of a single turn wound alongside the fourth turn of the main winding, as shown in the illustration.

---

a rotatable loop aerial along the lines of the one in the panel, reproduced from our Projects and Circuits book. A loop aerial can discriminate to a degree against local electrostatic noise impulses, while it can also null out signal sources (noise or unwanted stations) which are exactly broadside to it.

If the receiver has a normal aerial coil, connect the pickup loop to the aerial and earth terminals. Where the receiver is a portable, with its own internal ferrite rod, it is essential to make sure that the natural pickup of the rod does not compete with that of the loop. If the receiver has external aerial and earth terminals, try rotating the receiver to see which way reinforces the pickup of the large loop. Either that, or stand the receiver on end, to minimise direct pickup by its ferrite rod.

Where the receiver is small enough, don't worry about connecting the loop to it at all. Mount the receive inside the large loop, so that it rotates with the loop, with the ferrite rod running through the loop like an axle. The large loop will couple magnetically into the rod. Too much trouble? I guess it depends on how desperate one is to hear something other than "Blue Hills".

One final point: it may be that other readers are in a position to help C.K. with practical experience in similar situations. Or may be there's a receiver or two on the market which is particularly suited to "back o' beyond" situations.

It's over to you.

Using the CA3130 operational amplifier

When the word 'CMOS' is mentioned, most people automatically think of the well known series of digital devices or of microprocessors. However, RCA has recently introduced a new operational amplifier which combines the advantages of both CMOS and bipolar transistors on a single chip. Here we examine the characteristics of the new device and describe some typical circuit applications.

by J. BRIAN DANCE, M.Sc.

Designated the CA3130, RCA's new operational amplifier offers several attractive performance features. It has an input impedance of typically 1.5 x 10^{12} ohms, while input current is typically 5pA and input offset current is about 0.5pA at 25°C. The gain-bandwidth product is around 15MHz, and the slew rate is about 10V/us.

Typical applications include use in a wide variety of circuits, such as high input impedance comparators, long duration timers and monostables, high input impedance wideband amplifiers, voltage regulators, and photodiode amplifiers, etc. Several circuits are described later in the article.

Types

The CA3130 is available only in an 8 lead TO-5 type circular metal can. The CA3130A is selected for lower input voltage and input offset current than the more economical CA3130. The CA3130B has still tighter tolerances for its input specifications.

An additional suffix 'T' (for example, the CA3130T or the CA3130BT) may be added to show the device has straight leads, whilst a final suffix 'S' indicates the leads of the TO-5 are delivered bent so that their ends are in the dual-in-line configuration. All CA3130 devices are specified over the full 'military' temperature range of -55°C to +125°C.

Power supply

The CA3130 can operate from any supply voltage in the range 5V to 16V, or with balanced power supplies in the range ±2.5V to ±8V. The device can be operated with the input voltage 0.5V below the potential of the negative supply rail, whilst the output voltage can swing almost to the potential of either supply rail. These features render the device very suitable for use with a single positive power supply line instead of the split positive and negative lines required with many operational amplifiers.

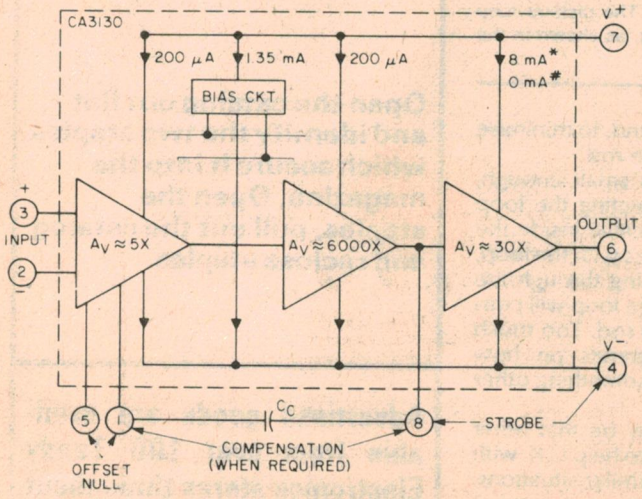
Electrical properties

The CA3130 contains three internal cascaded amplifier stages. The gain and current consumption of each stage is shown in Fig. 1. A biasing circuit is used to feed the first two stages.

The input stage employs two p-channel MOSFET (or PMOS) transistors so that the input impedance can be very high indeed. Four internal zener diodes are used to protect the oxide layers of the input devices against any stray static charges which could produce a potential large enough to puncture the oxide. The zener diodes conduct when the static charge at either input exceeds a certain level.

A potentiometer of value about 100k may be connected between pins 1 and 5, with the wiper arm connected to the negative supply line (pin 4), so that the offset can be 'nulled'. A fine offset-null adjustment can usually be effected with the slider arm near to the mid-point of its range.

The CA3130 input current is typically 5pA at 25°C, this being mainly leakage current passing through the gate protecting diodes. The value of this current is roughly doubled for each 10°C rise in temperature, as with any reverse biased semiconductor junction. The variation of



TOTAL SUPPLY VOLTAGE (FOR INDICATED VOLTAGE GAINS) = 15 V
* WITH INPUT TERMINALS BIASED SO THAT TERM 6 POTENTIAL IS +7.5 V ABOVE TERM 4
# WITH OUTPUT TERMINAL DRIVEN TO EITHER SUPPLY RAIL

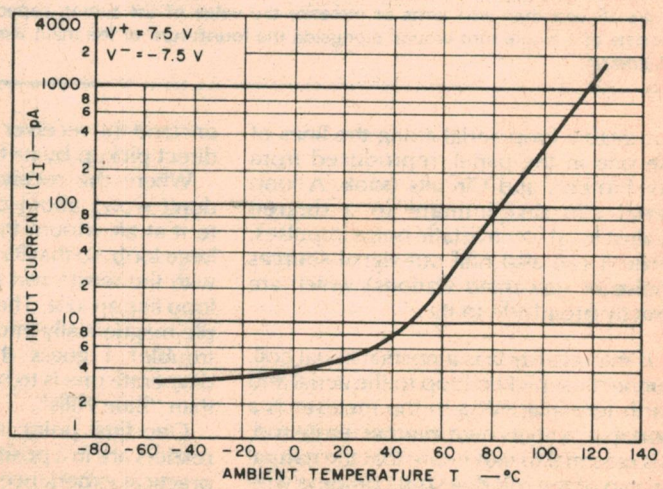


Fig.1 (left): the three internal amplifiers of the CA3130 in block form. A biasing circuit is used to feed the first two stages. Fig. 2 (above) is a plot of the variation in input current with temperature for the CA3130.

the input current with temperature is shown in Fig. 2.

The second amplifier of the CA3130 provides most of the overall gain. It contains a single NPN bipolar transistor which drives a cascade connected load. Frequency compensation is effected by connecting a small capacitor of value about 47pF between terminals 1 and 8.

The output stage consists of a drain-loaded inverting amplifier using CMOS transistors operating in class A. When this stage feeds a high impedance load, the output voltage can swing to within a few mV of the potential of either supply line. The gain of the output stage is dependent upon the load impedance.

Handling

The gate electrodes of the MOSFET input transistors of the CA3130 are protected against high potentials which can arise as a result of static charges forming at the input. Nevertheless, it is wise to exercise reasonable care in handling the CA3130 to reduce the possibility of damage.

The following precautions are recommended:

(1) Soldering iron tips, tools and any metal handling facilities should be grounded.

(2) CMOS devices should not be inserted into or be removed from circuits whilst the power is applied, since transient voltages can cause damage.

(3) Signals should not be applied to the input when the power supply is off.

(4) Input terminal currents should not exceed 1mA.

Typical applications

Voltage follower: In a voltage follower circuit, the output voltage 'follows' the input voltage very closely. The source of the input voltage may have a very high impedance so that it is not suitable for supplying current directly to a load, but this input can feed a CA3130 voltage follower which in turn feeds current to the load. The high input impedance of the CA3130 makes it especially suitable for this application.

A CA3130 voltage follower operating from dual power supply lines is shown in Fig. 3, whilst Fig. 4 shows a similar circuit operating from a single power supply line.

Circuits such as these may be employed in the input stages of digital voltmeters, etc.

(2) Astable circuit: A simple astable circuit which generates square waves is shown in Fig. 5. Resistors R1 and R2 bias the non-inverting input of the CA3130 to a point mid-way between the two supply line voltages. The timing capacitor is selected by S1. If the voltage across this timing capacitor is initially low (ie, a low voltage at the inverting input), a high output voltage at pin 6 will be produced.

The timing capacitor charges through VR1 and D1 until the inverting input potential exceeds that of the non-inverting input and the circuit switches.

CA3130 op amp

The output voltage falls to a low value and the timing capacitor now discharges through D2 and VR2. When the potential at the inverting input falls below that at the non-inverting input, the output will switch back to its former high voltage state.

The use of the high input impedance CA3130 device in this type of circuit has the advantage that one can use high value resistors in series with the two diodes and therefore the frequency can be very low, even with fairly small values of timing capacitor. The ON (output voltage high) and OFF (output voltage low) times are independently adjustable using VR1 and VR2 in the circuit shown.

If one wishes to alter the ON time whilst simultaneously changing the OFF time in the opposite sense, VR1 and VR2 should be replaced by a single potentiometer which has its slider connected to the positive line and its track ends to R4 and R5 respectively.

The circuit shown in Fig. 5 enables the pulse periods to be adjusted over the very wide range of 250:1 with each of the capacitors shown. The timing capacitors used in the S1 circuit must not be electrolytics, since the latter type of capacitor passes a relatively high leakage current which could not flow through VR1 and VR2 when these components are set near to their maximum value.

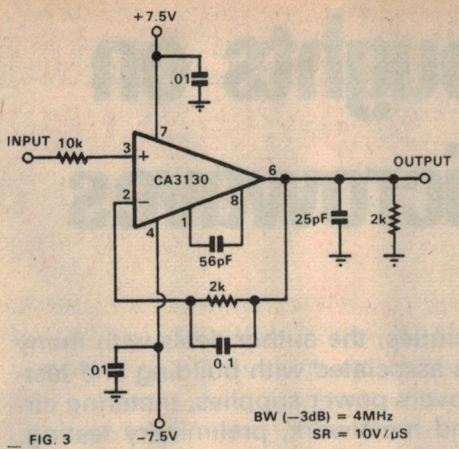


FIG. 3

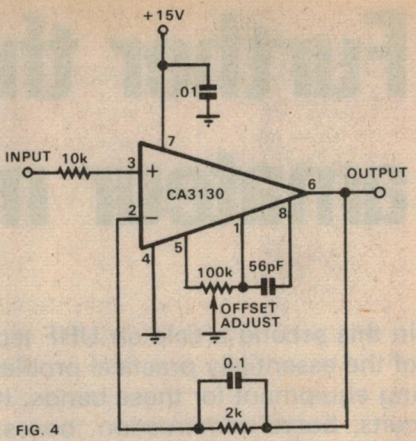


FIG. 4

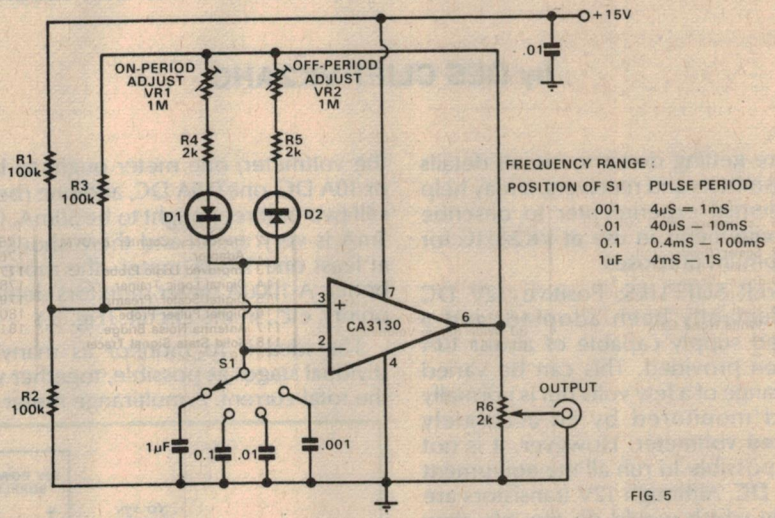


FIG. 5

Waveform generator

A circuit which generates triangular and square waves is shown in Fig. 6. Perhaps its most remarkable feature is that the frequency of oscillation can be adjusted over a range of 1,000,000:1 (0.1Hz to 100kHz) by the use of a single variable resistor without any range changing. A voltage-control input is also available for remote sweep control.

The CA3080 is an operational transconductance amplifier used here as a voltage controlled current source. The output from this stage is a current which is applied directly to the integrating capacitor C1 in the feedback loop of the CA3130 which provides the triangular wave output.

The final CA3130 stage is a switch which sets the limits of the triangular wave output and provides a square wave output. This square wave signal is also fed back via R4 to switch the current source to generate the required positive or negative current. The variable capacitor C2 can be used to adjust the corners of the square wave output for optimum shape.

Other applications

Various other applications of the CA3130 are given in the data sheet (RCA File number 817), including its use as an error signal amplifier in regulated power supplies, its use in peak signal detectors, in ideal full wave rectifiers, and in 9-bit digital to analog conversion.

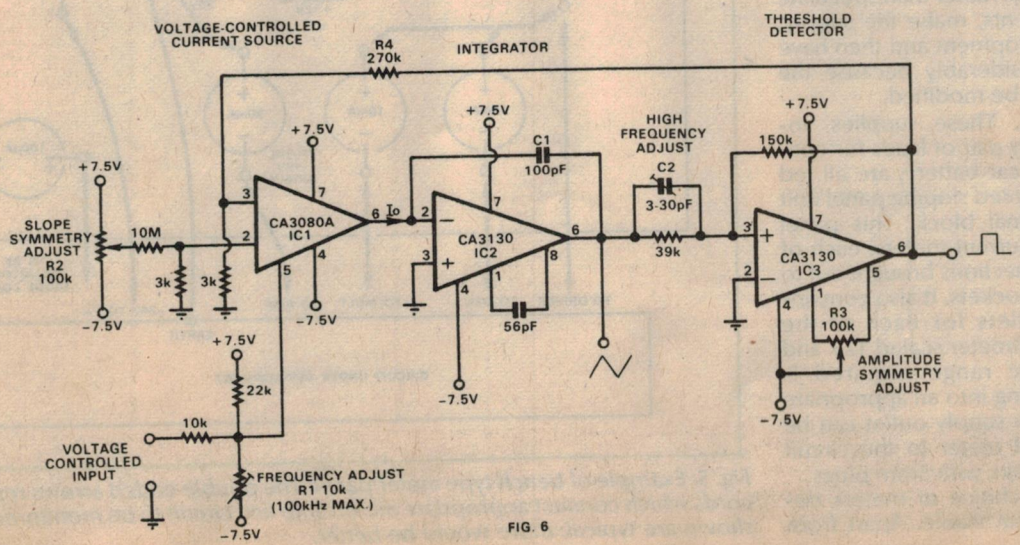


FIG. 6

Further thoughts on amateur microwaves Part 2

In this second article on UHF techniques, the author deals with many of the essentially practical problems associated with building and testing equipment for these bands. It covers power supplies, metering circuits, board construction, boxes and metalwork, preliminary testing, etc., as well as some of the unexpected problems which can occur.

by DES CLIFT VK2AHC

Before getting down to circuit details for transmitters and receivers, it may help the potential experimenter to describe the arrangements in use at VK2AHC for development purposes.

POWER SUPPLIES: Positive 12V DC has reluctantly been adopted, and a stabilised supply capable of about 10A has been provided. This can be varied over a range of a few volts but is normally set and monitored by an accurately calibrated voltmeter. However, it is not always possible to run all the equipment off 12V DC. Although 12V transistors are available which would do the job, they are usually expensive and not available as surplus. On the other hand 18V, 24V and 28V types can be obtained much cheaper and in some cases, surplus. So an 18V and 24V 2A dual stabilised supply has been provided for these. These supplies need not be elaborate.

Two or three 6V lantern batteries are also most useful, last for years, and are a good back up to the above. For anything requiring more than the basic 12V, the writer prefers to complete the design work using bench supplies. Only then provide the supply, rather than speculate on the requirements, make the supply, use it in the development and then have to modify it considerably because the basic plan had to be modified.

METER PANEL. These supplies, together with a hefty pair of leads for connection to a 12V car battery, are all fed into a bench mounted sloping panel unit via a large terminal block. This panel contains several current meters, each of which has its connections brought out to front panel 5mm sockets. It also contains 5mm socket outlets for each of the supplies and a voltmeter scaled 12V and 30V. The voltage range required is selected by plugging into an appropriate socket. Thus, each supply outlet can be fed via a selected meter to the circuit under test using links with 5mm plugs.

Obviously, the choice of meters depends on what is available. Apart from the voltmeter, one meter ought to be 5 or 10A DC, one 0.5A DC, and one (better still two or three) ought to be 50mA. One 5mA is very useful and there should be at least one 100uA meter—the more the better. A 100uA meter monitors detector points, etc., in the circuit. (Fig. 5.)

The idea is to monitor as many individual stages as possible, together with the total current. A multirange meter can then be used to full advantage, not being permanently connected to the circuit. The arrangement may seem expensive on meters but these are available in surplus equipment.

Dozens of meters from units which were "unsaleable" for less than the price of the meters themselves, have been salvaged and put to good use. There are also quite inexpensive meters around these days—indication rather than accuracy is often the real requirement; 10% to 15% is quite OK.

PROTOTYPE BOARDS. For circuits using transistors and I/Cs, and operating up to 460MHz, the method described in Electronics Australia October '73, is still preferred at VK2AHC. This uses Zephyr pins mounted in holes milled out of both sides of double sided board.

The RF components are strung from feed through or stand off by-pass capaci-

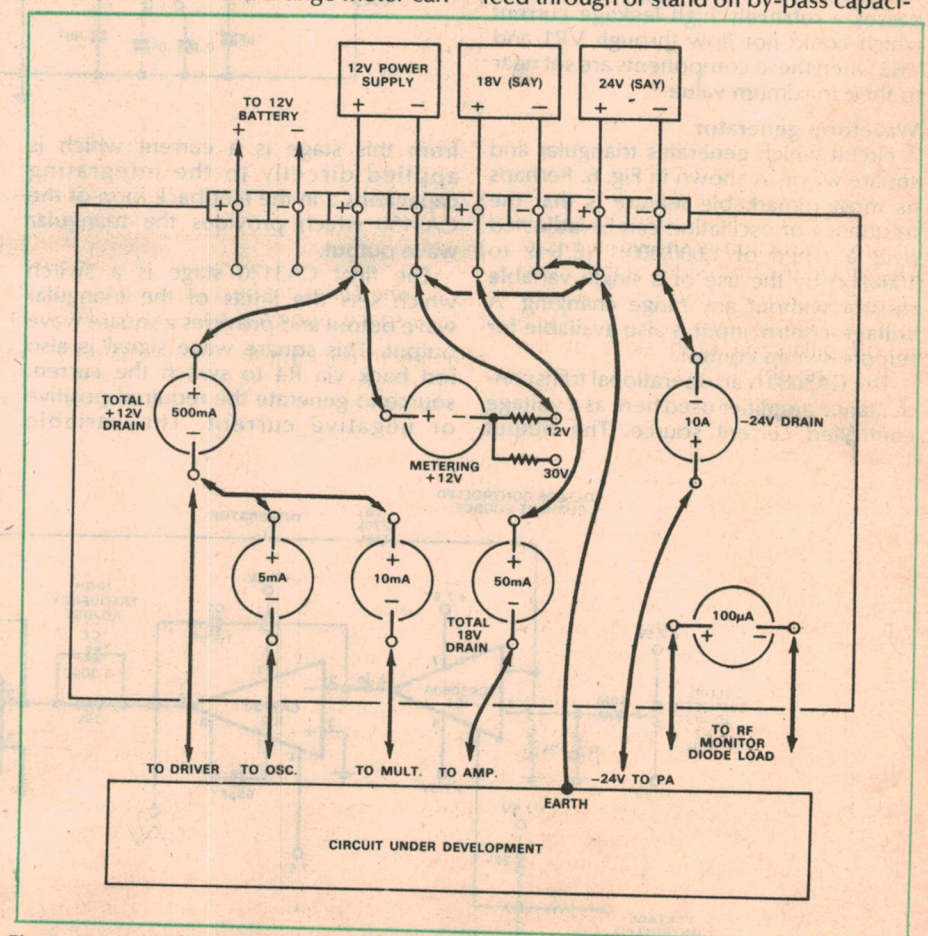


Fig. 5. Example of bench type meter panel. The double ended arrows represent patch cords which connect appropriate meters into any circuit to be monitored. The meters shown are typical; more would be better.

tors. It is usually necessary to make a real prototype of the initial stages such as the crystal oscillator, modulator and first two buffer or multiplier stages. When the placement of the parts has been made and its output measured, the final model is made on a piece board cut to the size required by the box or chassis used.

The later multiplier stages, which are usually much simpler in design and layout, are then added stage by stage to the driven unit. It is very advantageous to do a mock up layout of the final stages, starting from the output and working back. The layout should closely follow the circuit diagram.

It is important to link together both sides of double sided board, at frequent intervals. Drill suitable size holes at about 3in intervals around the outer edge, and at each side of the transistors, pass a piece of tinned copper-wire through each hole and solder it to the copper on both sides.

Try not to use all the space and leave enough to add a low level stage should the desired output not be achieved. This is facilitated by making the output of the driver unit 50 or 75 ohms and the input of the final stages the same, both linked by a short length of coaxial cable.

Use of the widely available (but not cheap) cast boxes is highly recommended for complete separation and modular construction. About their only disadvantage is that they usually require a piece of circuit board as a sub-chassis. Think twice about using the lid as a chassis—it is often more effective and convenient to use the circuit board sub-chassis mounted on stand off pillars.

This necessitates having all the tunable controls on one side. An example of this form of construction is shown in Fig. 6. It is helpful to use both sides of the board as an aid to stability and space saving. During construction, use four decent size stand-off pillars on both sides of the board to prevent damage to the components.

GENERAL COMMENTS: Transistor circuits cannot usually be dipped in situ like valve circuits. However, as the higher frequency collectors and outputs are normally tapped well down the coil, the tuned circuit can be dipped before assembly and an allowance made for the loading. Very early in the chain one usually reaches the top of the dip oscillator range and has to rely on experience to get the circuits to resonate. It is surprising how easy it is to get a stage off its desired frequency so that is amplifies the fourth harmonic rather than the third and so on.

It is not unusal for the crystal oscillator frequency to appear in quite large proportions at the output, which may be 8 or 9 times the crystal oscillator frequency. It may be filtered off at the low level 8 or 9 times stage by a separate interstage trough line bandpass filter, which also helps to clean up other spurii. Try to avoid exclusive use of capacitor couplers throughout the whole chain by using at least one LC bandpass coupler.

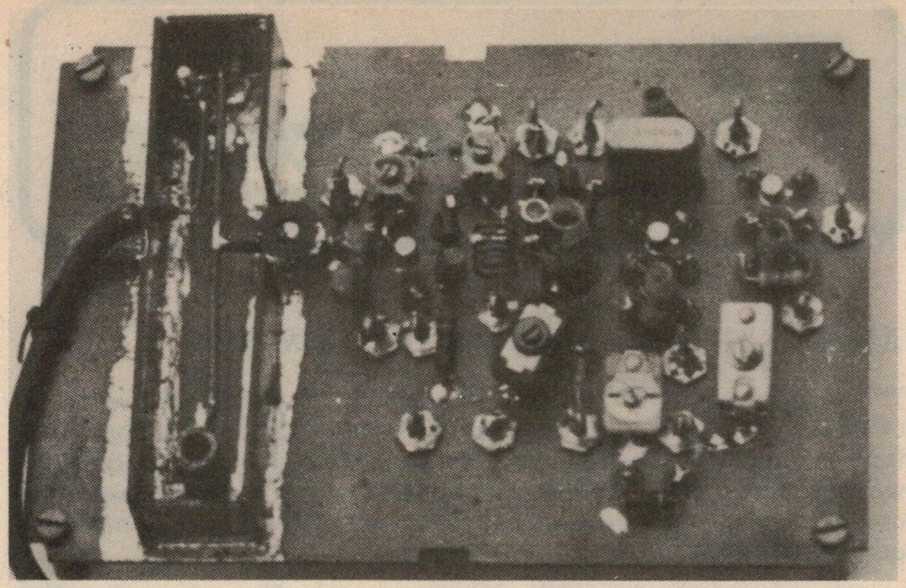


Fig. 6. Example of a circuit board used as a sub-chassis. It is fitted with stand off pillars to facilitate mounting in a die cast box.

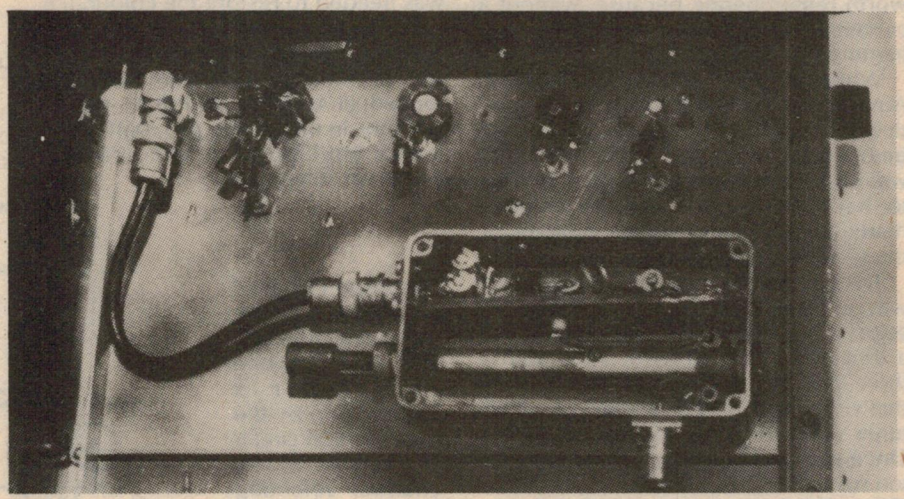


Fig. 7. Tuned lines are best adjusted by starting at one quarter wavelength and pruning to save space. Shown is part of a tripler from 193.6MHz to 581MHz.

Air capacitors should be used wherever possible. Polar 0-10pF obtained new or surplus are very useful but have to be handled with great care as they very easily short. The renowned Philips concentric air trimmers are very useful but can present problems, due to their size, at 300MHz and up. E.F. Johnson type "T", "U" and "V" in various values (imported by General Electrics Services) are available through the usual sales outlets and seem superior in that they come in a wider range, are small and seem less prone to short.

Only high quality dieclectric type concentric trimmers should be used. Home made concentric air trimmers are best for tuning trough line circuits above 500MHz.

As an aid to getting the circuits for these frequencies correct, use a line as long as possible to start with (nearly one quarter wavelength) and then, only if necessary to save space, gradually prune this and progressively add capacitance to make it resonate. An example is a tripler from 193.6MHz to 581MHz; part of a 3400MHz crystal controlled set. (Fig. 7.)

A word of warning. Check the effectiveness of bypass capacitors as each stage is made up. Make sure that adding a .01uF or 0.1uF across the selected bypass makes no difference to the drive to the next stage.

Also, when measuring current in a HT line for tuning make sure that returning a bypass lead to its proper position in the HT feedline, rather than through long temporary leads, makes no difference to the next stage drive.

A recent experience of instability in a three stage amplifier tuned to 104MHz showed the tuned circuit to be actually resonant at nearly 150MHz when bypassed with a particular type of stand-off 1000pF bypass capacitor used without a parallel capacitor. Two other types of 1000pF bypass capacitors gave the correct resonant frequency of 104MHz and the instability disappeared.

(To be continued)

The Serviceman

Modern TV sets—more and more complex

The modern colour TV set is a far cry from the black and white set of yesteryear, which was more like a crystal set by comparison. Apart from the fundamental differences between black and white and colour, we now have touch tuning and remote tuning systems; extremely complex circuits in their own right. For the serviceman they represent quite a challenge.

This story is about a Toshiba colour TV set with a most unusual fault. It is a story worth remembering because, without a certain amount of luck I might still be trying to track it down.

While Toshiba sets are available in Australia, being handled by EMI, this particular model is not. Apparently it had been bought in Japan while the owner was on an overseas trip. Also, it appeared to have been made for the German market in the first instance, judging by the German words on the chassis.

The part for concern was the tuner. It was a touch control type capable of selecting eight channels. Each circuit had a trim pot which, in association with a three position switch, was used to set that circuit to any VHF channel or a UHF tuner with which the set was also fitted. Once adjusted, a finger on the touch button was all that was needed to select that channel.

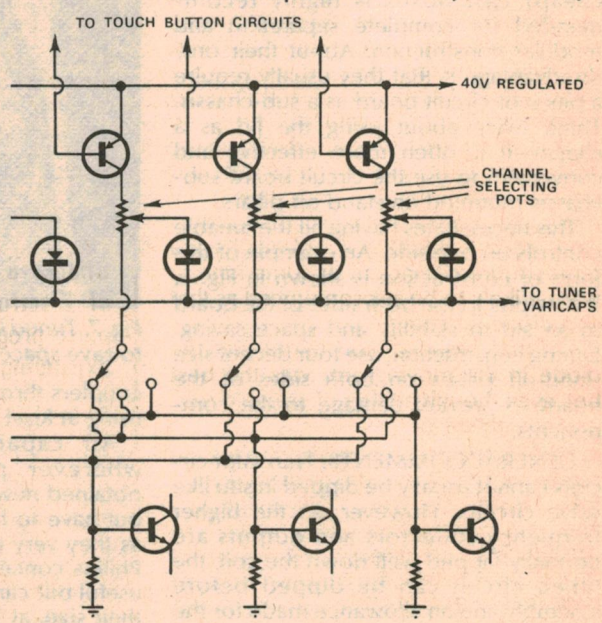
The owner—or somebody—had set up the first four touch buttons to select the four Sydney channels; 2, 7, 9, and 10. Then, apparently on an impulse, they had set up the remaining four buttons in a repeat configuration. And the complaint? Channel 7, if selected by the upper button, would not produce colour, but would if selected by the lower button.

Perhaps it is a comment on our times, and the blase attitude which comes with familiarity, that the customer found this situation mildly annoying. A few years ago most of us would have been prepared to travel quite long distances, and press any number of buttons, just to see colour TV!

Nevertheless, the complaint was genuine enough in the technical sense. It should have been possible to receive any selected channel by means of that circuit, and in colour. And, in any situation where all eight channels needed to be used, failure on one could be a real problem.

Initially, I imagined that the problem would amount to no more than an off-frequency setting of the pot, which could be restored with a minor adjustment. Sure enough, a quick twiddle was all that was needed to restore the colour.

Fortunately, I put the set to one side and let it run for a while, just in case. And just as well, because the next time I looked at it the colour had vanished. Another tweak of the pot shaft brought it back but I quickly realised that it was a heat sensitive fault.



Simplified circuit of portion of the touch selection system. When any one transistor is switched on by the touch button circuit it connects the channel selecting pot to the 40V rail. The diodes in the moving arms isolate the pots from each other. It was one of these diodes which developed the temperature sensitive fault.

The question was, which component had become heat sensitive? My first reaction was to blame the oscillator circuit varicap, but a few moments' thought ruled that idea out. The varicap is common to the oscillator circuit, so that any fault would show up on all channels.

That seemed to leave only the trim pots as being peculiar to each channel and I found it hard to accept that one of these had become heat sensitive.

Fortunately, the owner had had the foresight to obtain a service manual with the set (none was available in Australia) and I pulled this out and took a closer look at the tuner and associated circuitry.

The first thing that struck me was the complexity of the touch button mechanism and the fact that it was still being made with discrete components. With three transistors for each channel it used no less than 24 active components, plus several times this in passive devices—nearly as many as used by some complete TV sets in years gone by! Such a configuration would be a logical candidate for an IC and I was surprised to find it in this form.

But all that is by the way; it was the actual channel selecting mechanism that interested me. At a quick glance, it seemed to follow the broad general principles of most that I have seen so far. The tuned circuits—oscillator, RF stage etc—were tuned by varicaps which, in turn, were controlled by two voltages via a suitable mixing circuit. One voltage was from a pot connected to a regulated supply rail, the pot being the control used to select the channel. The second voltage was from the sound discriminator, via an amplifier, and provided the AFC function in what is now a fairly standard arrangement.

The "top" of each of the eight pots was fed from a regulated voltage via the touch tuning circuit; selecting a channel applied voltage to that pot. The moving arm of the pot was then adjusted to supply the correct voltage to the varicap to select the required channel.

This meant that, in effect, each moving arm was connected to a common rail; the rail that applied the appropriate voltage to the varicaps. To effectively isolate each pot, each moving arm was connected to the varicap rail via a diode.

The "bottom" of each pot was eventually returned to chassis via one of three rails, the particular one being selected by the setting-up technician according to whether the channel required was a low band or high band one, or whether the UHF tuner was required. In the process of returning to chassis it activates one of three "band switching" transistors.

Having sorted all that out, I asked myself what would be most likely to cause a temperature drift in one particular channel. Well, it had to be something which was peculiar to that channel, and it had to be something which was likely to develop a temperature sensitive fault.

Assuming that we ruled out resistors for the moment (they were all metal-oxide types) it seemed to me that the two most likely culprits were either the switching transistor connecting voltage to the pot, or the diode in series with the pot moving arm. I did consider the transistor connected to the bottom of the pot, but ruled it out on the grounds that it was common to several channels.

From a purely practical point of view, I was anxious to make the best assessment possible. None of the components in this part of the set were particularly accessible and I had no wish to indulge in a series of awkward replacements on a "suck-it-and-see" basis.

At this point I rang a colleague who, as well as being well versed in the basic principles of voltage controlled tuners, was rather better informed than I on the behaviour of diodes—including varicaps —and transistors under varying temperature conditions.

Having outlined the circuit I put my suspicions to him. In general, he agreed with me, but went on to explain that the temperature behaviour of a bottomed transistor was not necessarily the same as that of a diode junction. Most of the voltage developed between emitter and collector was due more to a resistive like mechanism than to a junction effect. And, while it would undoubtedly have a temperature coefficient of some kind, it was unlikely to be as pronounced as that of a diode junction.

On that basis we concluded that the diode in the moving arm was the best bet, even though neither of us could suggest the nature of the fault.

Back at the bench I tackled the task of removing the diode. It was an awkward job, to say the least, calling for fine tweezers, my smallest iron, and a set of double jointed fingers! When it was finally out my main thought was that our joint reasoning had better be right.

Without too much optimism I put the diode across the ohmmeter, hoping I might get some indication of a fault. But it wasn't going to be as easy as that; the diode read normal in both directions. Even so, having taken it out it was no harder to replace it with a new one, which I did.

Then I switched on, selected channel 7, and tuned it up for a good picture. After that there was nothing I could do but wait. Happily, after several hours of running, the picture was still in full colour and I considered the point proved. After some more tests the following day I returned it to the customer, then rang my friend to tell him the good news and thank him for his help.

And what was wrong with the diode? That remains a mystery. Apart from the obvious fact that it seemed to be excessively temperature sensitive, neither my colleague or I can suggest why this should have been so.

Still, I found it, and that is the main thing.

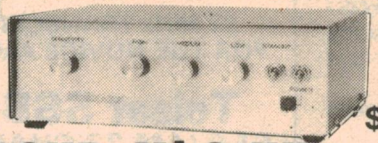
Finally, a brief comment by another serviceman (C. A. of Rutherford N.S.W) about my story in the July issue concerning the faulty focus pot in a Pye receiver. He writes, "It was with some surprise that I read your article in the July magazine. The fault you describe is so common as to be monotonous, so much so that Pye have now introduced a modified version of the focus assembly."

Then he goes on to mention several other sets which suffer from a similar problem. These include HMV, Healing, Philips and Siemens. Some, in fact, use the identical component.

Thank you, C. A., and I'm sure our readers will be grateful for your help. As for being surprised that I should describe this fault—well, what is so strange about that. It was the first time I, or several colleagues, had encountered the fault and I was intrigued by it, just as I imagine you were, the first time you struck it.

(Editorial note: There is another aspect which the correspondent could not appreciate. For a variety of reasons, stories must often be held over for several issues. This was one such; it would have been more topical when it was written.)

THE AUSTRALIAN COMPANY



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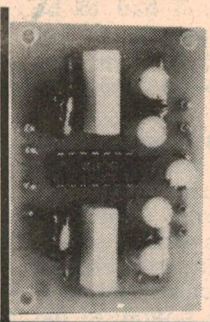

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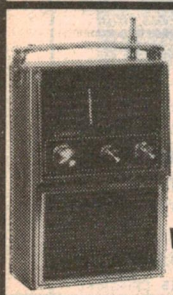

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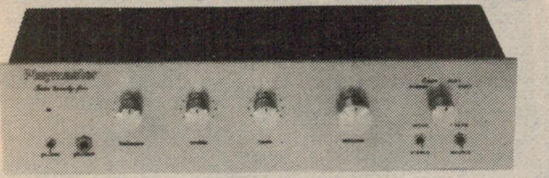

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$1.20

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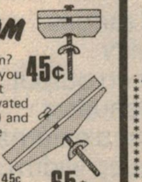

Want to make your own beam? Or repair one? These'll make you happy. They're aerial element brackets, in two styles: Passivated steel (takes 1/2" to 5/8" rod) and an insulated polystyrene type (takes 3/8" rod).

45c **65c**

Cat D-4650 (poly) 45c
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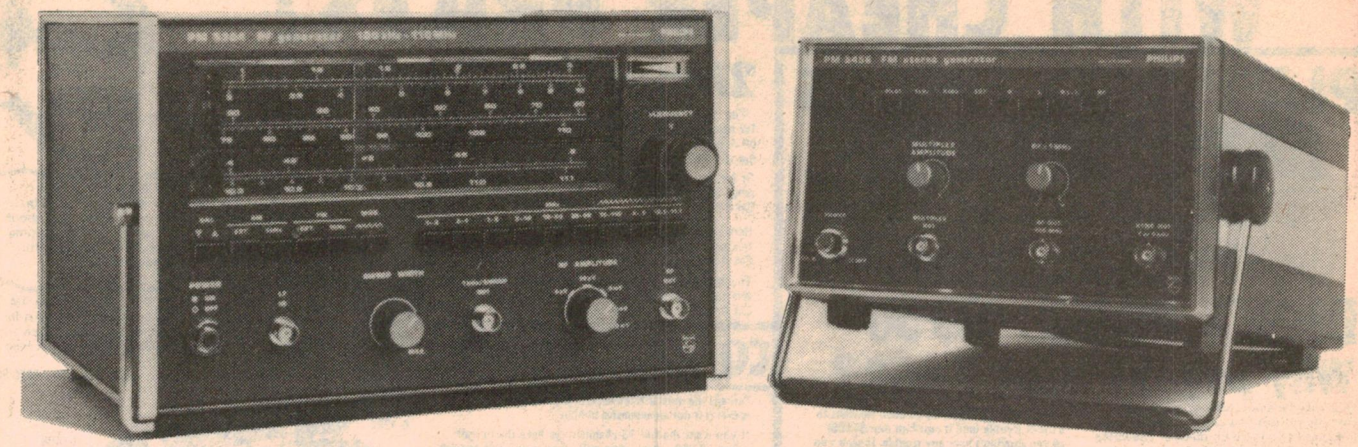

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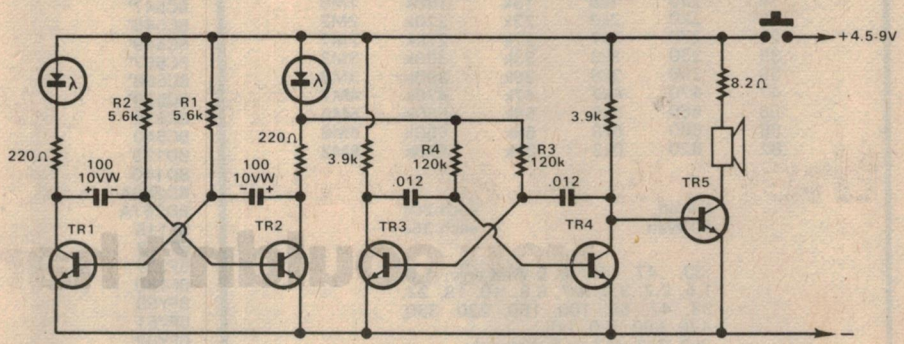
Circuit & Design Ideas

Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Hee-haw siren for toys

This hee-haw siren was installed in a toy fire engine in order to provide a more interesting realistic toy. Although many siren circuits have been described, this one has the advantage that a wide variety of transistors may be used, and it also provides one or two flashing beacons.



Transistors TR1 and TR2 form a multivibrator with a period of about 0.6 second, flashing the LED beacons and "frequency modulating" the multivibrator formed by TR3 and TR4. TR5 amplifies the output and drives the speaker.

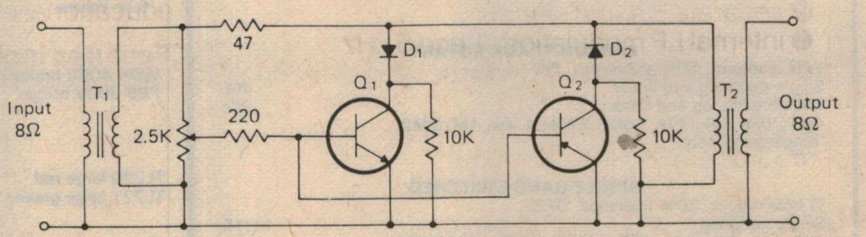
In the unit constructed, the output transducer was a telephone receiver insert, which has the advantage of being rugged and waterproof. A small speaker from a scrapped transistor radio could also be used. If a speaker with an impedance greater than 22 ohms is used, the series resistor may be omitted. If only one beacon is required the LED in the collector circuit of TR1 may be omitted and 220 ohm resistor increased to 560 ohms. A normally open push-button is used as an on/off switch, as this cannot be left on unintentionally by a child.

An intriguing toy may be made by replacing R1/R2 and R3/R4 with 10k and 220k ganged potentiometers respectively and mounting the circuit in a small plastic case. The resultant wide variety of pulsed tones and variable frequency flashing lights can keep children occupied for long periods.

(By Mr A. Ohsberg, PO Box 178, Nedlands, WA 6009.)

An audio-powered noise clipper

Unlike many noise suppression or clipper circuits which involve complex modifications to the average receiver, this audio powered noise clipper can be quickly inserted in the speaker circuitry. The transistorised audio powered noise clipper, shown in the diagram, is designed to operate in 4 to 8 ohm receiver speaker output circuits. The original circuit was designed to operate in 600 ohm radio telephony circuits. The author added 600-to-8 ohm line transformers for impedance matching and substituted other transistors for the JAN (militarised) transistors.



The use of the 600-to-8 ohm impedance matching transformers provides for two requirements. In order to use this noise clipper in 4 to 8 ohm speaker circuits, an 8-to-600 ohm transformer must be used on the input side and a 600-to-8 ohm transformer must be on the output side. The second need for this change in impedance is that the voltage levels in the 8 ohm circuit may not be high enough to allow the noise clipper to operate effectively. Tests made by the author showed that the voltage clipping level has a minimum level of approximately 1.5V peak-to-peak.

The circuit is quite straightforward. Two transistors, powered by the audio power contained within the signal, will short out signal peaks which exceed the threshold established by the 2.5k potentiometer. The diodes are used to isolate the positive and negative clipping circuits represented by the NPN and PNP transistors, respectively. The adjustment of the 2.5k potentiometer is left to the discretion of the user. Normally, a desired audio operating level can be established and the potentiometer needs little or no further adjustment. However, it is to be noted that adjusting the potentiometer to a no clipping level effectively removes both transistors from the circuit and the noise clipper presents very little insertion loss in the speaker audio circuit.

(By Clayton Laster, W5ZPV, in "CQ".)

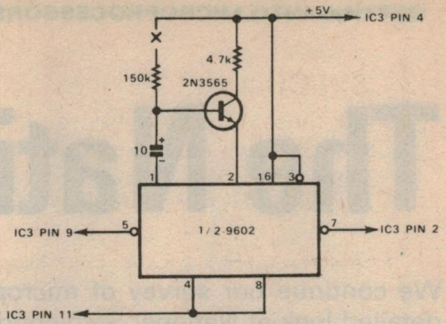
Editorial note: In the parts list, the author specifies Archer type 273-1379 transformers, or any transistor radio output transformer with 500-to-4 ohms impedance. If neither alternative is available, it is possible that small power transformers, such as Ferguson type PL24/5VA could be used instead. Also type 1N270 diodes are specified. If these are unavailable, then any general purpose germanium diode, such as the 0A91 should be satisfactory. Q1 is a 2N2222 and Q2 is a 2N2907. These should be available but if not, suitable substitutes should be easy to get.

Modification to Digital Frequency Counter

The automatic sequencing feature of the 200MHz Digital Frequency Counter described in "Electronics Australia" in December, 1973, is ideal for measuring frequency to the nearest 10Hz and for periods greater than 100mS. If the sequencing cycle is shorter than about 400mS, the last digit becomes unreadable, and in the instances when the last three digits are 000 or 999, then the entire display becomes unreadable as the counter cycles between these two values. This problem is often encountered if the frequency being measured is a multiple of say, 100kHz, or if the period is a multiple of 10mS.

Fortunately there is an easy modification to the sequencer which corrects this deficiency. By placing a clear pulse of sufficient duration onto IC3 pin 2 at the end of the count phase, the sequence can be stopped long enough to give a readable display. In my counter I am using a fixed delay of 450mS, but there is no reason why this may not be extended or even made variable by inserting a 1M potentiometer at X in the circuit shown. I have used half of a 9602 dual monostable, but either a 9600 or 9601 may be substituted with suitable input modifications.

Connection to the existing board is



simple, requiring only the isolation of IC3 pin 2 from the supply line. This can be done by carefully cutting around the pin. The IC and components were mounted on a piece of DIP board and attached to the back of the main counter board, requiring only four connections to IC3 as shown.

(By Mr H. J. Harvey, Modbury North, SA 5092.)

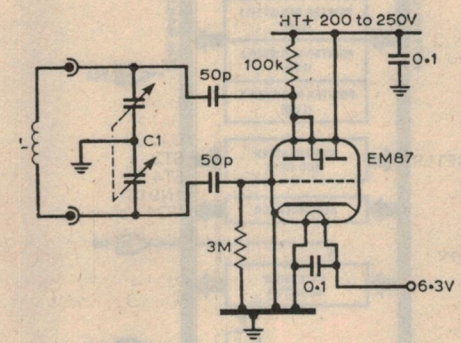
Magic-eye wide range GDO

The idea of using a "magic eye" tuning indicator as the indicator for a grid-dip oscillator has a long and respectable history. But there is emerging a generation of amateurs to whom semiconductors have become the "norm" and to whom thermionic devices are no longer associated with measuring and test equipment.

However, the "magic eye" is not only much cheaper than the combination of meter, amplifier and detection plus RF generator normally employed, but is also more rugged and easier to read. The design shown here reduces the number of components to an absolute minimum. Since solid-state dippers also include a battery and meter they are rarely any smaller or more compact than this EM87 unit which in my case measures 9cm x 6cm x 4cm. Of course one requires a cable connection to a power supply, but that is less objectionable than one might think.

In fact when the system was found to work my existing solid state dipper was immediately scrapped. I found the magic eye dipper to provide the following advantages: (1) despite the rather large tuning capacitor, it was possible to achieve results up to 160MHz without spurious dips; (2) the lowest frequency attainable with a 104mH RF choke is 60kHz.

The incorporation of low frequency



ranges permits the checking of low frequency crystals (FT241), alignment of 455kHz IF stages, and even lower frequency IF stages found in some of the older receivers such as National and Hammarlund. Eleven coils on octal valve sockets are required for the full coverage of 60kHz to 160MHz. The variable capacitor is a Jackson 2 x 176pF.

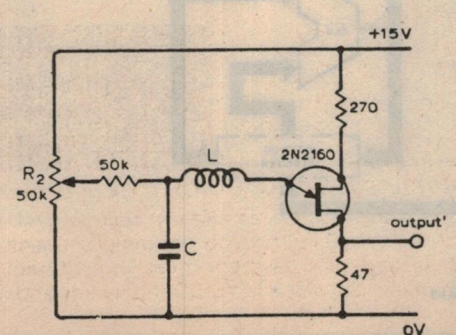
(By F. A. S. Sterrenburg, in "Radio Communication".)

Simple sine-wave oscillator

This circuit provides a simple AF sine-wave oscillator by using a unijunction transistor as a negative resistance in an RLC circuit. The potential divider R2 sets the peak point of the emitter and should be adjusted for maximum output consistent with a good sine wave. The output is about 200mV and the circuit operates from 1kHz to 50kHz by using suitable values of L and C.

It may be possible to get lower in frequency by using larger values of L and C and could be worth trying.

(By R. P. Hart, in "Wireless World".)



The National SC/MP

We continue our survey of microprocessors this month with a more detailed look at National Semiconductor's 8-bit SC/MP chip. We also take a look at the low-cost SC/MP evaluation kit, which has already aroused a lot of interest, and its more powerful "big brother" the SC/MP development system.

by JAMIESON ROWE

In addition to the 16-bit PACE microprocessor which was examined in our August issue, National Semiconductor also currently produces an 8-bit chip. This is called SC/MP, which is short for "Simple Cost-effective Micro-Processor" (and pronounced "scamp"). As the name suggests, SC/MP was designed primarily for lower level applications than PACE; applications where cost effectiveness is a major consideration.

Like the PACE chip, SC/MP is an MOS/LSI device using silicon gate, P-channel technology—although it uses depletion mode devices instead of the enhancement mode devices used in PACE. A faster N-channel version of SC/MP is currently in development, and is mooted for early in the new year.

The basic architecture of SC/MP may be seen from the diagram on this page. There are a total of 10 internal registers, five of which are 8 bits in length while the other five are 16 bits long. Data input and output takes place via an 8-bit parallel bidirectional bus, while there is a separate dedicated 12-bit address bus.

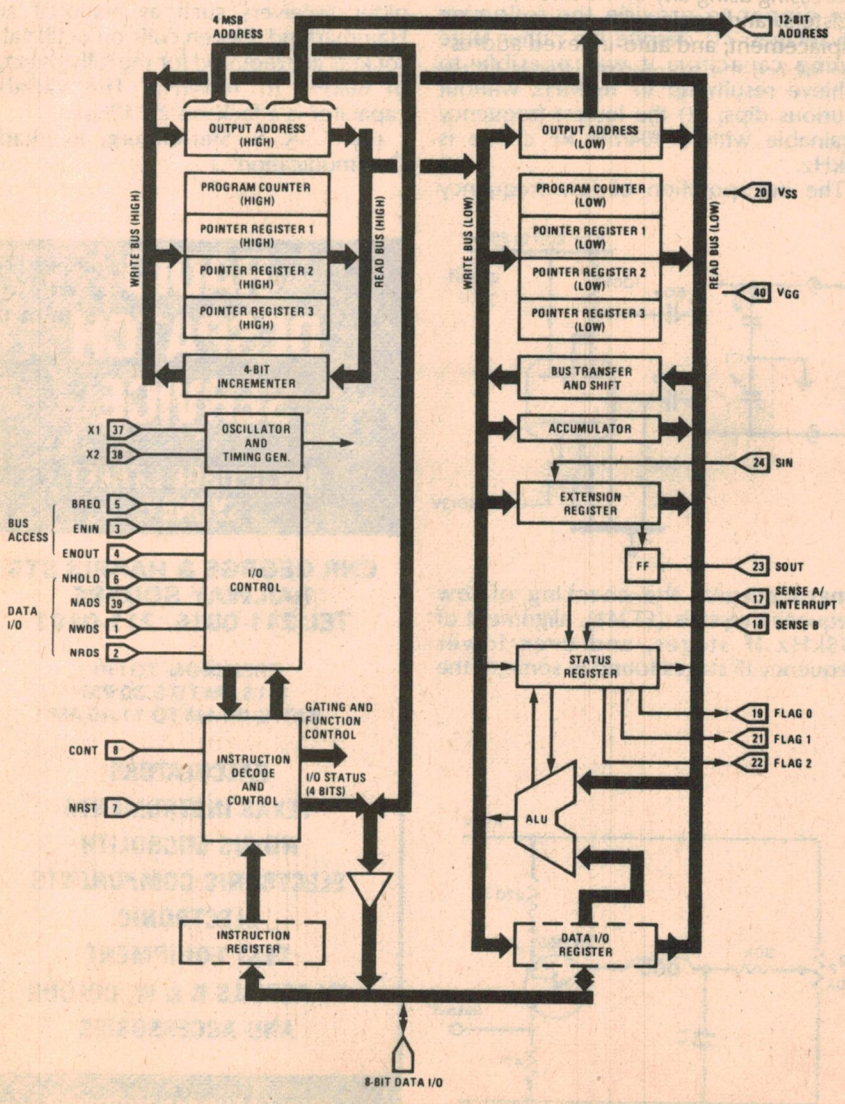
There is only one nominal 8-bit accumulator register, but this is effectively supplemented for logical and arithmetic functions by the 8-bit extension register. The other 8-bit registers are the status register, the data I/O register, and the instruction register.

Of the five 16-bit registers, one is an output address register which is transparent to the user. The remaining four are pointer registers, one of which is dedicated as the program counter. The other three are available to the programmer as addressing pointers.

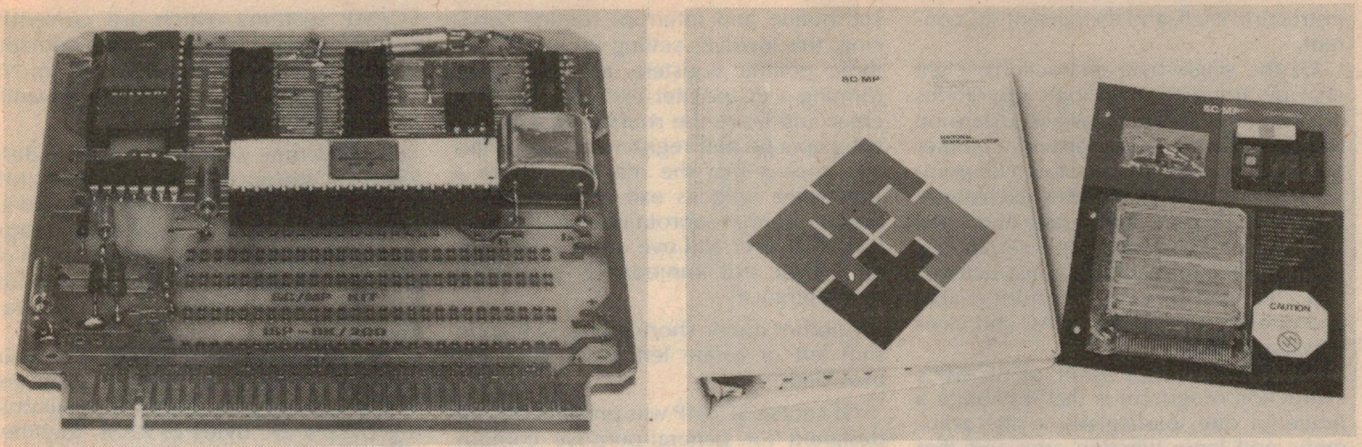
As the program counter and pointer registers are 16 bits long, this means that SC/MP has the ability to directly address 65,536 bytes of memory, or "65K". However the chip's address bus handles only the 12 least significant bits, the remaining four bits being multiplexed out of the chip on four of the data bus lines. In addition there is no carry-over to the four most significant bits when the program counter (PC) is incremented, so that memory space is effectively divided into sixteen pages of 4096 bytes each.

Of the 8 bits in the status register, three are used for user flag signals which are made available at device pins. Another two bits are sense bits, again brought out to device pins. One of the sense inputs also serves as an interrupt input if another of the status register bits is set to a 1. The remaining two bits are an overflow bit and a carry/link bit, used for arithmetic and shift-rotate functions.

The SC/MP chip provides five control signals to facilitate data input-output and bus accessing. These are address strobe (NADS), read strobe (NRDS), write strobe (NWDS), bus request (BREQ) and enable outputs (ENOUT). There are also five control inputs, namely reset or initialise (NRST), continue (CONT), bus enable (ENIN), bus busy (BREQ) and extend I/O cycle (NHOLD). Note that the BREQ pin is used for both input and output of control signals.



At left is the basic architecture of the SC/MP chip, taken from the maker's data.



Above is the low-cost SC/MP evaluation kit as it comes, while at left is a view of the assembled PC board. An edge connector is supplied.

Many of the control signals provided by the SC/MP chip are not required for simple systems, but are used in more elaborate systems for such purposes as direct memory access (DMA) and similar operations.

SC/MP has its own internal clock oscillator, which can use either a capacitor or a quartz crystal for timing as required. Alternatively the oscillator can be disabled and the chip fed from an external clock source, via the two timing terminals.

In short, then, the SC/MP chip is quite a flexible 8-bit microprocessor. While designed primarily to make it capable of forming the heart of low cost minimal-device controllers and dedicated systems, it is also provided with many of the facilities required for more elaborate systems.

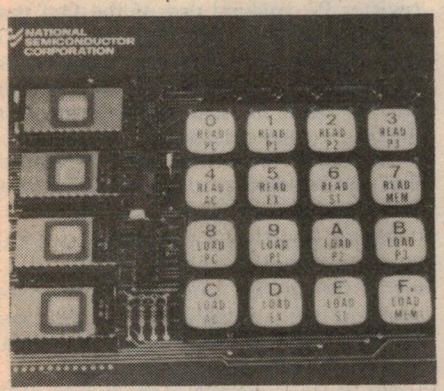
On the software side, SC/MP has a repertoire of 46 basic instructions of which 22 are 2 bytes in length, and the rest are a single byte. Fourteen of the 2-byte group are memory reference instructions, and comprise load, store, AND, OR, exclusive-OR, decimal add, add, complement and add, increment and load, decrement and load, jump, jump if positive, jump if zero, and jump if not zero.

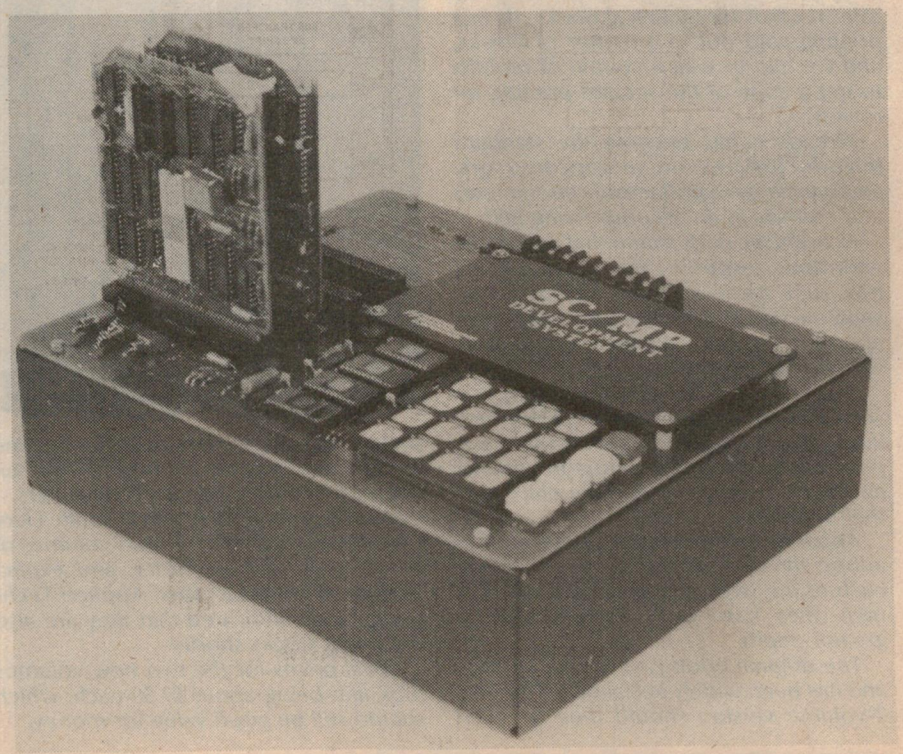
Each of these fourteen instructions may use one of three addressing modes. These are PC-relative addressing with a signed 8-bit displacement (giving a range of from -128 to +127, decimal); indexed addressing using any of the three pointer registers, and again with a signed 8-bit displacement; and auto-indexed addressing where the pointer register is either post-incremented or pre-decremented depending upon the sign of the 8-bit displacement.

In addition to these normal memory reference instructions there are no less than seven immediate-addressing instructions, wherein the data or mask operand is contained in the second byte of the instruction itself. The seven instructions are load immediate, AND immediate, OR immediate, exclusive-OR immediate, decimal add immediate, add immediate, and complement and add immediate.

Note that both the normal complement-and-add instruction and the complement-and-add immediate instruction may be used for 2's complement subtraction, by setting the carry/link bit beforehand.

The remaining double-byte instruction is a delay instruction. This may be used to provide programmable delays of from 13 to 131,593 machine microcycles, or from 26 microseconds to 263.186 milliseconds with a 1MHz clock. The delay is a function of both the displacement in the second byte of the





At right is a view of the larger SC/MP development system, with a close-up of its keyboard and EPROMs shown above.

instruction itself, and the current AC content.

Of the single-byte instructions, eight provide arithmetic and logic operations involving the accumulator and extension registers. Three more provide pointer register move operations, to cover pointer loading and PC-pointer exchanges. Five more provide shift, rotate and serial I/O operations, while the remaining eight provide miscellaneous instructions: halt, clear and set carry, interrupt enable and disable, copy status to AC and vice-versa, and NOP.

Overall, our impression of SC/MP's instruction repertoire is that it is quite a powerful one, particularly in the arithmetic and logic function area and that involving immediate instructions. These plus its "special features" such as the delay instruction and the inbuilt serial I/O would make it very well suited to dedicated computer and controller applications.

It would be less suitable for general-purpose computer applications, due to a number of limitations. One is the lack of true absolute addressing. Another is the relatively clumsy way it handles subroutine and interrupt routine servicing; this involves setting up one of the three pointer registers, and then performing a PC-pointer exchange to both enter and leave the routine. Apart from tying up a pointer register each time, this also means that the machine leaves a subroutine with its exit address in the pointer, so that subroutines which are to be called over and over must effectively have their exit immediately preceding their entrance!

Another minor shortcoming is that no shift left or rotate left instructions are provided.

Of course SC/MP was presumably not designed for general-purpose computing, so these criticisms must be judged accordingly. It is also true that given almost any instruction set one can write almost any program, once one gets fully familiar with its strengths and weaknesses. With most of us the main limitation on our programming is likely to be our own skill, whatever the chip we elect to use!

Having looked at the SC/MP chip itself, let us now look at the two small SC/MP systems which are currently available from National Semiconductor. In Australia these are available from NS Electronics Pty Ltd, or in one-off quantities through their distributors.

The system which is more widely known at present is the low-cost "SC/MP Kit", which is a minimal-system do-it-yourself evaluation kit. It comes as a large ring binder containing a complete set of parts in a blister pack, together with full assembly and programming information.

The assembled kit forms a very basic system, but one which is quite sufficient to allow development of small programs. It provides 256 bytes of RAM, together with 512 bytes of ROM containing "Kitbug"—a very basic monitor-debug program. The kit provides a 1MHz crystal for the SC/MP clock, together with the interfacing circuitry required to communicate with an ASCII teleprinter or similar 110-baud asynchronous serial terminal using a 20mA current loop.

The kit requires an external power supply providing +5V at approximately 350mA, and -12V at 200mA.

There are only three commands recognised by Kitbug: Type (T), Modify (M) and Go (G). The T command causes printout of successive memory locations and their contents, in hexadecimal, until a keyboard input is detected. The M command is similar, except that it types out a single location and provides for modification of the contents followed by either a return to Kitbug, or progression to the next location. This is the command used to load programs into the kit, and also the means for setting up the starting address and initialising the SC/MP registers prior to running. Finally the G command transfers control to the user's program, to run it.

A fourth command can be simulated, namely a user's program halt which transfers control back to Kitbug. This may be done only where the user's program does not disturb the contents of pointer register P3, making use of the fact that Kitbug stores its own return address in that register when it transfers control to the user's program. Hence by inserting an "exchange PC with P3" instruction in the user's program, control may be transferred back to Kitbug when required. This can be used as a simple breakpoint system when debugging.

Price of the low-cost evaluation kit is currently quoted as $79.95 plus tax, making it the lowest cost microprocessor evaluation kit available and the cheapest possible way of acquiring practical experience with microprocessors.

The more elaborate of the two SC/MP systems currently available in Australia is the Low Cost Development System or "LCDS", which as the name suggests is

EXCELLENT TEXT ON MICROPROCESSORS

AN INTRODUCTION TO MICRO-COMPUTERS, by Adam Osborne. Published by Adam Osborne and Associates, Inc, 2950 Seventh St, Berkeley, California. Soft covers, 133 x 206mm, about 380pp. Price in US $7.50.

In the last year, this book has apparently broken just about all previous US sales records for technical books. Its first printing sold out in a matter of weeks, and we had to wait a couple of months to get a copy of the second printing for review.

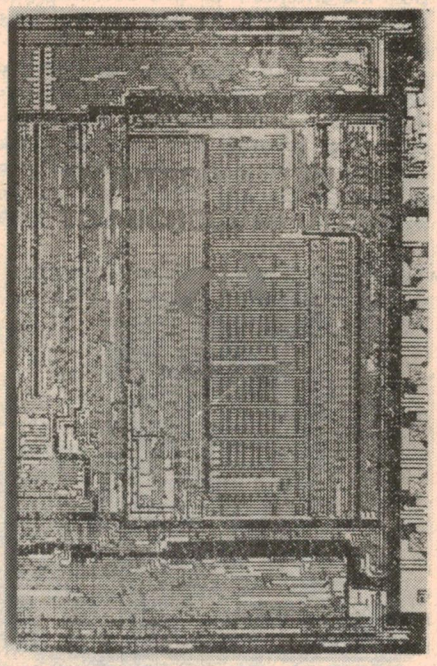
Already it has become the standard introductory text on microprocessors, and is used by many factory-run seminars and courses as an accompanying text.

Actually we understand that due to the enormous response, the original book has just been expanded into two separate volumes. By the time this review appears, the two volume version may well be the only one available.

The original book is divided into two sections: an introductory section which leads the reader through all the basic concepts of microprocessors in general, and then a survey of specific chips and their features.

Apparently the new 2-volume version adopts the same approach, but by giving each of the two sections a volume of its own, they have both been treated in greater depth.

The original book is very well written, and has been widely acclaimed. The new 2-volume version should thus be even



better, and an excellent book for anyone looking for a good up-to-date text on microprocessors and microcomputers.

We understand that Dick Smith Electronics have supplies of both volumes of the new version on order, and expect supplies by mid-October. Applied Technology have indicated that they are also obtaining stocks shortly.

Local prices for the two new volumes look like being about $7.50 each, which should still be good value for money.

```
;NOVELTY ANSWER-BACK PROGRAM FOR SC/MP KIT. D.ROWE, E-A 31.7.76

200 C4 01    LDI 01       /SET UP P3 FOR CALLING GECO
202 37       XPAH P3
203 C4 65    LDI 65
205 33       XPAL P3
206 3F       XPPC P3      /GO LOOK FOR INPUT CHAR,ECHO
207 E4 0D    XRI 0D       /CR? (AC WILL HAVE ZERO IF YES)
209 9C FB    JNZ (PC)-5   /NO; KEEP GOING
20B C4 C4    LDI C4       /YES;SET UP P3 FOR CALLING PUTC
20D 33       XPAL P3
20E C4 0A    LDI 0A       /GO PRINT LF
210 3F       XPPC P3
211 C4 02    LDI 02       /SET UP P1 AS ANSWER POINTER
213 35       XPAH P1
214 C4 25    LDI 25
216 31       XPAL P1
217 C1 00    LD (P1)+0    /FETCH ANSWER CHAR
219 3F       XPPC P3      /PRINT
21A C5 01    LD @(P1)+1   /FETCH CHAR AGAIN,INCREMENT PTR
21C E4 0D    XRI 0D       /CR?
21E 9C F7    JNZ (PC)-9   /NO; KEEP GOING
220 C4 0A    LDI 0A       /YES; PRINT LF
222 3F       XPPC P3
223 90 DB    JMP (PC)-37  /RETURN TO LOOK FOR NEW INPUT

225 47 4F 20              /START OF ANSWER BUFFER
228 41 57 41
22B 59 2C 20
22E 49 27 4D
231 20 42 55
234 53 59 21
237 0D                    /ANSWER MUST END WITH A CR

TO RUN IN SC/MP KIT, PUT SA OF 200 IN PC STORAGE LOCATIONS 2F7 AND
2F8, THEN GIVE "G" COMMAND TO KITBUG
```

Written for the low-cost SC/MP evaluation kit, this simple answer-back program utilises the TTY servicing routines in the Kitbug ROM.

intended not so much as an evaluation kit, but as a small system for the development of programs and application systems.

The basic LCDS consists of a base supporting a large PC mother board, on which are mounted four 72-way edge connectors together with a small keyboard array, a display panel with six 7-segment LED readouts, and various other ICs including four 512-byte PROMs with a resident monitor-debug program. With the assembly comes a plug-in PC card which provides the SC/MP CPU, its clock, a 256-byte RAM and a full complement of buffers for all data, address and control lines.

Hooked up to a +5V/-12V power supply, the basic LCDS forms a limited but self-contained system using the on-board keyboard and LED display for communication. However the resident monitor-debug firmware also has provision for asynchronous serial interfacing, so that it is only necessary to connect up a teleprinter or similar terminal in order to begin more serious development work.

In teleprinter mode, the LCDS resident debug program has a powerful set of functions. It can type out the contents of all SC/MP registers, alter any of these contents at will, type out memory locations singly and modify these at will, type out sections of memory, set or remove a breakpoint, punch a selected range of memory into paper tape, load a program into memory (either the original locations, or into another area as required), and initiate execution.

The basic LCDS thus forms a more powerful "big brother" to the small evaluation kit, and as such is much more suitable for serious development of SC/MP programs.

Of course the 256-byte RAM provided on the basic CPU card is a limitation when it comes to developing larger programs. Accordingly National make available two further types of plug-in card, which may be purchased separately and plugged in as required to expand the system. One card provides an additional 2k bytes of RAM, while the other provides sockets for up to 4k of ROMs or PROMs. Both cards may be programmed using wire links to respond to a specific range of addresses in the total SC/MP memory space, so that a number of cards may be used to expand the system as far as required.

Price of the basic LCDS system complete with the CPU card is currently quoted at $405 plus tax. The optional 2k byte RAM cards are quoted at $130 each plus tax, while the 4k ROM/PROM card (less ROMs or PROMs) is $100 plus tax.

NS Electronics kindly made available to us one of the SC/MP kits for evaluation, and the author was able to put it together and gain "hands-on" experience with a minimum SC/MP system.

The assembly instructions which come with the kit are quite explicit, and I found no difficulty putting it together. Just to be safe I observed the usual precautions when soldering in MOS devices, but even this is really only necessary with the RAM devices because both the SC/MP chip itself and the ROM are provided with sockets.

In operation the Kitbug program provides pretty basic debug facilities, but once you get used to it you can develop small programs fairly easily. Out of interest I developed a novelty "answer-back" program, to duplicate the one I did for the 2650 system described last month. Again this was interesting, as the program makes use of the teleprinter servicing routines in Kitbug.

The program went together fairly easily, once I got used to the slightly tricky aspects of SC/MP subroutine servicing. It is reproduced here in the article so that readers can try it out if they feel so inclined.

NS Electronics also very kindly loaned us one of the LCDS development systems, partly to allow us to compare it with the smaller system, and partly to assist in our development of a project we have been putting together based on a SC/MP kit.

The LCDS system was complete with one of the 2k-byte RAM cards, and when I "fired it up" the increased flexibility compared with the small kit quickly became apparent. Not surprisingly, it is much easier to develop programs when you can dump and load them conveniently using paper tape, and when you can quickly insert and remove breakpoints in the program to check out sequences and isolate bugs.

In fact I found the LCDS a very convenient development system, and one which makes development of SC/MP programs a very efficient and smooth business. At the price asked, it should be a very attractive investment for anyone intending to do serious development of SC/MP programs and systems.

Both the SC/MP evaluation kit and the LCDS system components should be available in all states via NS Electronics distributors. If you require further information, this should be available from NS Electronics at either Cnr. Stud Road and Mountain Highway, Bayswater, Victoria 3153, or 2-4 William Street, Brookvale, NSW 2100.

PACER PRICE: NS Electronics has advised that the prices quoted for the PACER system, and given in our August article, were in error. The actual price for the unassembled unit is $728 plus tax, while the assembled unit is $833 plus tax.

SC/MP Low Cost Development System

The SC/MP Low Cost Development System (LCDS) is a simple controller configured to provide maximum flexibility at affordable cost. It provides all the features necessary for development and testing of SC/MP hardware and software designs for a user's applications.

The minimum SC/MP Development System is configured with a SC/MP CPU Card plugged into one of four sockets in a Card Bus on a 10" x 12" motherboard. Also on the motherboard are a 16 key, dual-function, hexidecimal keyboard; four function keys; 3 control switches and a 6 digit hexidecimal display.

Control logic, scratchpad memory, and ROM based firmware on the motherboard allow the user to examine and alter the SC/MP registers, examine and alter memory locations, run SC/MP programs in continuous or single instruction mode or operate with an optional Teletype® using SC/MP DEBUG.

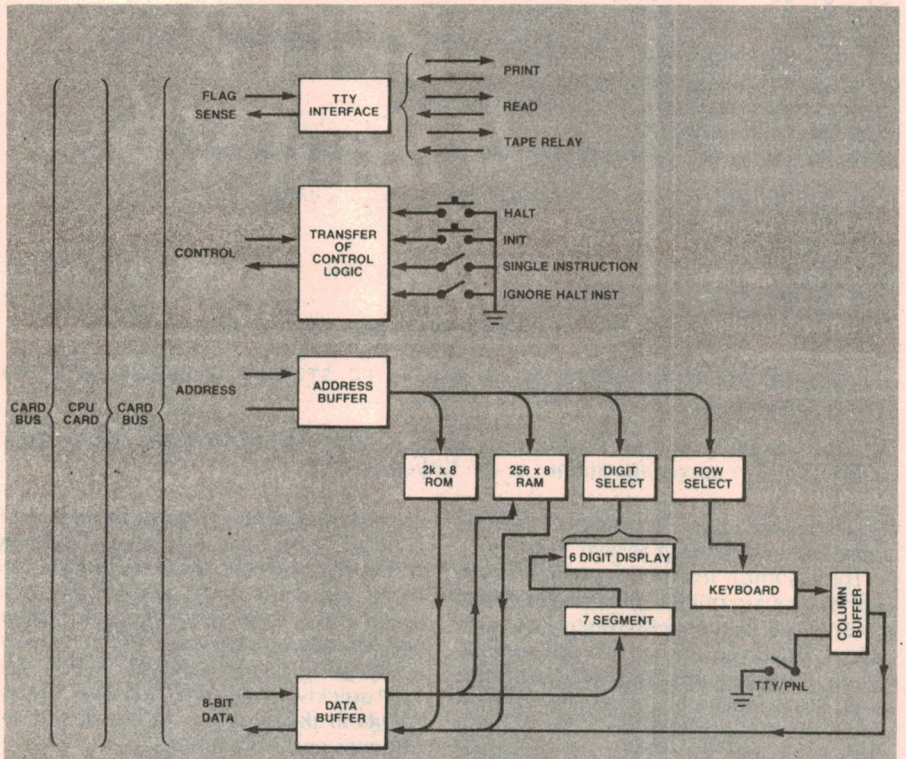


Figure 1: BLOCK DIAGRAM FOR MOTHERBOARD

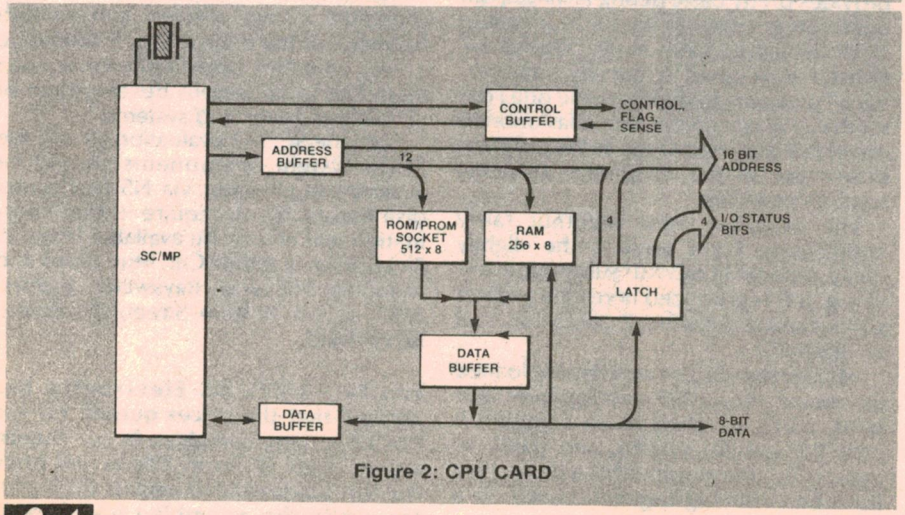


Figure 2: CPU CARD

FEATURES

Salient operating characteristics of the major items comprising the LCDS are as follows.

SC/MP C P U Card

The basic block diagram of the SC/MP C P U card (ISP-8C/100) is shown in Fig. 2. It provides the C P U interface for execution of user-generated application programs and development system resident firmware.

Pre-wired Application System Interface

Four prewired 72-pin edge connector sockets provide a plug-in interface for SC/MP family cards and permit interconnection of additional SC/MP applications hardware via user fabricated cabling. A fifth 72-pin edge connector can be added by the user. In addition, a flat cable connector can be added for coupling to an external card cage.

Interface Logic

Provides control and monitor functions that permit transfer of control between development system resident firmware and user-generated application programs.

Development System Resident Firmware Program

This firmware contains subroutines that permit entry of software debug commands via the programmer's control and display panel, or an optional Teletype.

For further information contact NS Electronics Pty. Ltd. Melb (03) 729 6333, Syd

Programmer's Control and Display Panel

Provides the following software debug capabilities:

- **Display contents of SC/MP program counter, registers, and accumulator in hexadecimal format.**
- **Alter contents of SC/MP program counter, registers and accumulator.**
- **Display contents of any memory location in hexadecimal format.**
- **Alter contents of any memory location.**
- **Initiate execution of user-generated application program at any memory address.**
- **Select single instruction or normal execution of user generated application program.**
- **Interrupt execution of user-generated application program at any point.**

Teletype Interface

Provides standard 20-milliampere interface for interconnection of optional Teletype. Expanded software debug capabilities associated with teletype option include:

- **Print contents of SC/MP program counter, registers, and accumulator**
- **Alter contents of SC/MP program counter, registers, and accumulator**
- **Print contents of any single memory location or selected range of memory locations**
- **Alter contents of any memory location or selected range of memory locations**
- **Set a breakpoint halt in RAM for user-generated application program**
- **Initiate execution of user-generated application program at any memory address**
- **Save application program by punching selected memory range to paper tape**
- **Load development system generated paper tape into memory**
- **Load IMP-16 or FORTRAN Cross Assembler generated paper tape into memory.**

Expanding the SC/MP Low Cost Development System

National Semiconductor offers various cards which may be used in conjunction with the SC/MP LCDS System. The 2K x 8 Read/Write Memory Card (ISP-8C/002) and the 4K x 8 ROM/PROM Card (ISP-8C/004) can be used to provide additional memory for user application or system development.

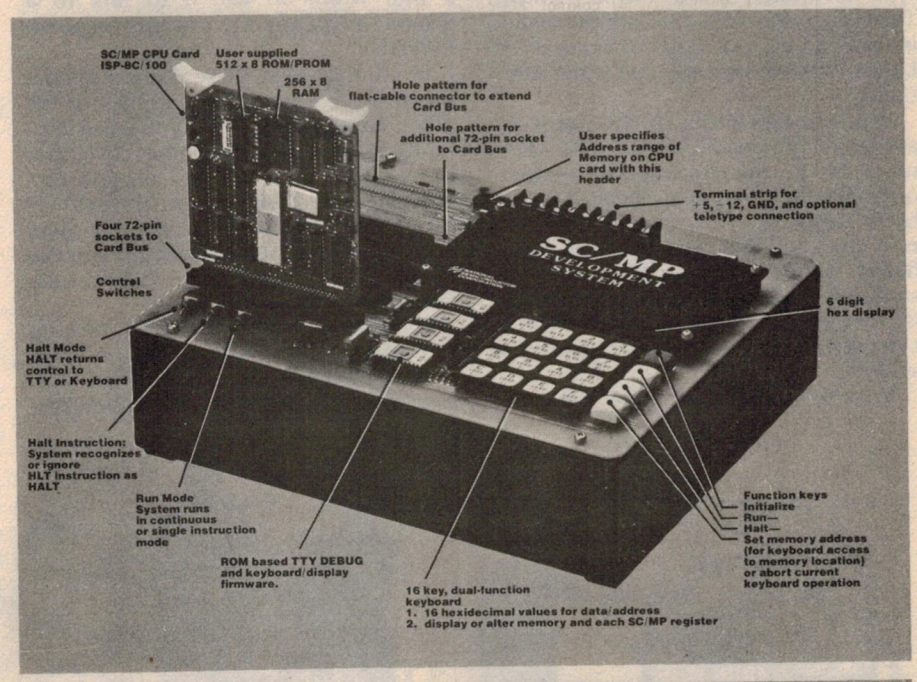
The standard Cards can be plugged into any of the connectors on the Card Bus. The bus is easily expanded by use of flat-cable to external user supplied modules.

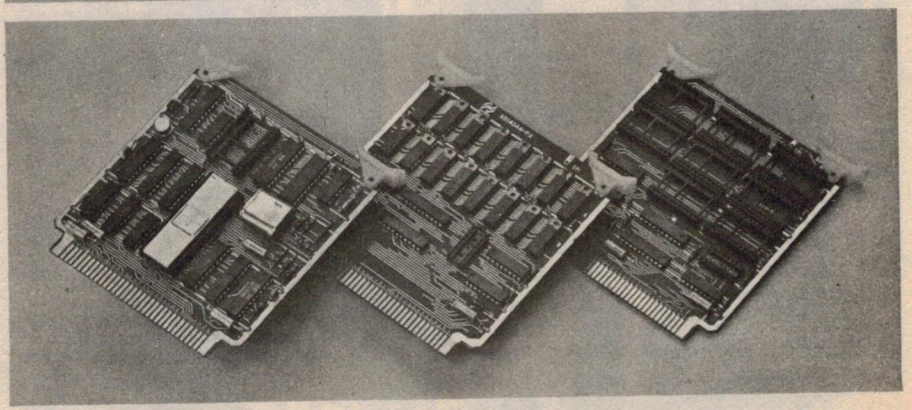
Typical use of the system provides capability to debug user systems with program in RAM, using features of DEBUG such as single instruction or breakpoints. Changes to the program can be made directly from the keyboard or teletype. When the program is running correctly, it can be dumped to paper tape for programming ROM or PROM.

Ordering Information

The SC/MP LCDS and supporting cards may be ordered directly from National Semiconductor or National's franchised distributor near you.

SC/MP Development System (includes one CPU Card)	**ISP-8P/301**
SC/MP RAM Card (2K x 8)	**ISP-8C/002**
SC/MP ROM/PROM Card (4K x 8) (includes eight 5204 PROMs)	**ISP-8C/004P**
SC/MP ROM/PROM Card (4K x 8) (without PROM Memory)	**ISP-8C/004B**
SC/MP CPU Card	**ISP-8C/100**





(02) 93 0481; Qld (07) 36 6604; WA (092) 25 5722; SA (08) 46 3929; Tas (002) 44 1337;NZ 491 282

First project using a dedicated microprocessor:

ASCII-Baudot translator

As far as we know this project is a world first—the first electronics construction project based on a dedicated microcomputer. Built around a SC/MP evaluation kit, it forms a "black box" which can interface a low-cost surplus Baudot teleprinter to any computer or microcomputer system requiring a 110-baud ASCII teleprinter. It should interest anyone looking for a way of "talking to" one of the new low-cost microcomputer systems at low cost.

by JAMIESON ROWE

Like most small mini-computers, most of the microcomputer evalution kits and development systems currently becoming available have been designed to converse with the user via a computer-type teleprinter such as the well-known Teletype model ASR-33. Communication is via 20mA current loops, at a rate of 110 bauds (bits per second), and in the ASCII code.

While teleprinters of this type are available fairly readily in the USA, where most of the microprocessor systems originate, they are not at all easy to come by in Australia. New, they are likely to cost you something like $1500 plus tax—hardly within the grasp of the average small user or would-be computer hobbyist, and rather out of proportion to the current cost of a typical microprocessor system.

Very few machines have appeared from time to time on the second-hand market, but even these have been relatively expensive. You could expect to pay anything from $400 up, depending upon condition. This is still rather a lot to pay if one wants to use it to talk to a microcomputer kit costing around $100-200!

In contrast with these computer-type teleprinters, quite good supplies of the older Baudot-type teleprinters are currently available at much lower cost, from firms dealing in surplus equipment. Machines of British, German and US manufacture are available, most of them having been sold as obsolete plant by the Army, Telecom and other public utilities.

For example you can currently pick up a Teletype model 15 page teleprinter for around $100, or a model 14 typing reperforator for about half that price. Similarly, Creed model 7A page teleprinters are available at about $120.

These machines are obviously quite attractive in terms of price, compared with the computer-type machines. However, they are not directly compatible with the majority of computer systems, for a number of reasons. The most obvious of these is that they use the 5-level Baudot code, instead of the 7-level ASCII code.

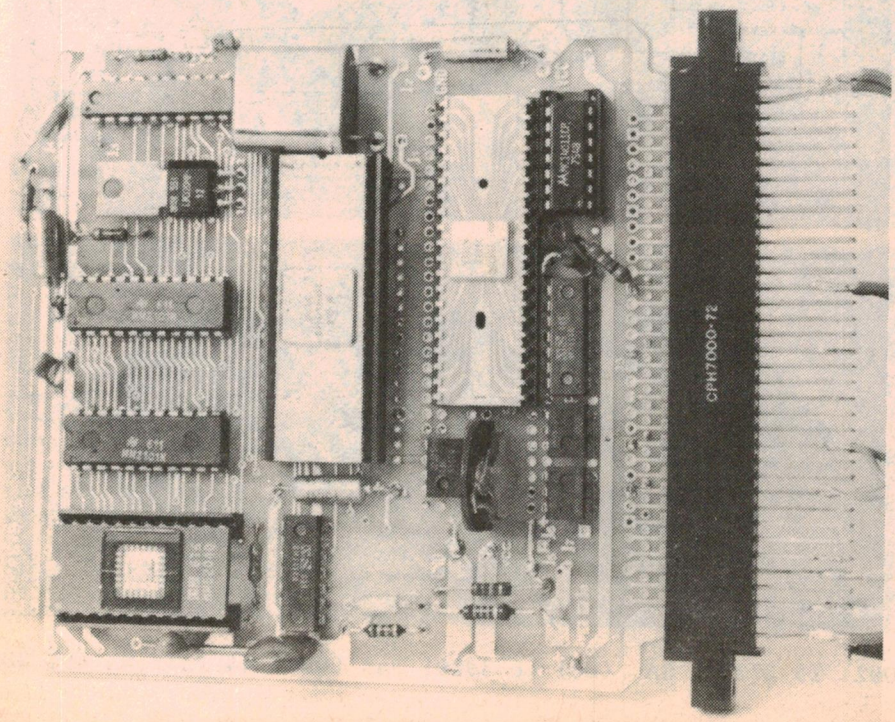
In itself, this is not an insurmountable problem. Code translation can be performed using suitable ROMs, although even this is not as simple as one might expect. This is because Baudot code is really a 6-bit code in which the normally missing 6th bit is effectively sent only when it changes value. It is sent in encoded form as special "letters" and "figures" characters, so that any code conversion system must be capable of performing the appropriate storage and "housekeeping" functions.

Quite apart from the problems associated with code translation as such, there is also another problem: speed. Computer-type machines mostly run at 110 bauds, and with a total of 11 bits per character, this gives a maximum character rate of 10 per second. In contrast, Baudot machines typically run at 50 bauds, and with a total of 7.5 bits per character, this gives a maximum character rate of around 6.5 per second.

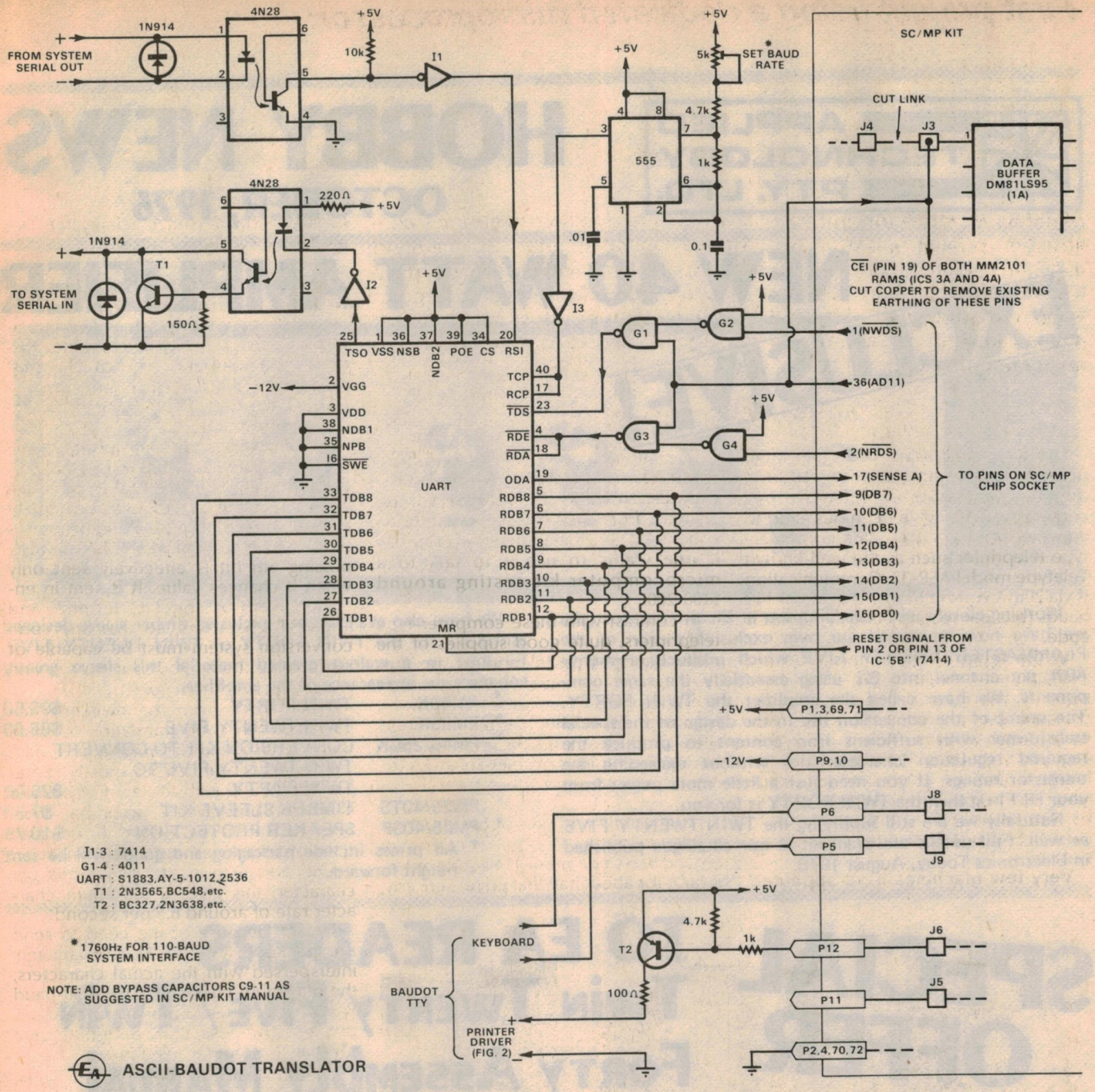
In fact, because of the need to send the special "LTRS" and "FIGS" characters interspersed with the actual characters, the maximum character rate of 50-baud Baudot machines in practice is nearer 5 per second—less than half that of a 110-baud computer teleprinter.

The difference in speed doesn't pose a problem for "inward" data flow, from the teleprinter keyboard to the computer system, because here the speed differential assists rather than opposes. However, the problem comes with "outward" data flow, from the computer system to the teleprinter print mechanism. The system is geared to output characters at a rate of 10 per second, while the Baudot printer can only "digest" them at a rate of about 5 per second.

As a result, it becomes necessary to provide temporary storage or "buffering", between the system output and the printer. The buffer must be of the "first-in-first-out" (FIFO) type, capable of accepting characters at the high rate,



A view of the ASCII-Baudot translator, built up on the SC/MP kit PC board.



ASCII-BAUDOT TRANSLATOR

supplying them at the slow rate, and accumulating the difference as required.

Hopefully you can see from all this that interfacing a surplus Baudot teleprinter to a microcomputer system isn't exactly the proverbial "piece of cake". There are quite a few functions to be performed, and to do the job with a conventional wired logic circuit would involve quite a lot of ICs and a complex PC board.

Happily, thanks to modern IC technology there is now an easier and more elegant way of doing the job. This is to use one of the low-cost microprocessor evaluation kits currently available, and turn it into a dedicated "black box".

This is the approach I have taken, and the ASCII-Baudot translator which will now be described is based on the SC/MP evaluation kit currently selling for around $80 plus tax.

On the hardware side, most of the functions of the translator are performed by the basic SC/MP kit circuitry. However, six additional ICs are required, along with two transistors and a hand-full of minor components. Most of these fit on the spare space provided on the SC/MP kit PC board.

The main supplementary IC required is a UART (universal asynchronous receiver-transmitter), which performs the 110-baud ASCII interfacing to the main computer system. The UART may be an S1883 (American Micro-systems Inc), an AY-5-1012 (General Instruments), a 2536 (Signetics), or any other exactly equivalent device. Note that not all UARTs currently available are exactly equivalent to these, however.

A 555 timer IC is used to generate the 1760-Hz clock signals required by the UART. Two 4N28 or similar low-cost opto-couplers are used to perform the actual interfacing to the main computer, to ensure that the translator is fully compatible with all systems designed for 20mA current loop signals. Transistor T1 is used to boost the current switching ability of the outgoing opto-coupler.

Schmitt trigger elements I1, I2 and I3 are used for inversion and signal squaring, while gates G1-4 are used to perform address decoding for the UART so that it effectively occupies location FFF in the SC/MP memory space. Transistor T2 is used to perform interfacing between the

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existing serial output of the SC/MP kit and the driver in the Baudot teleprinter.

Most of the signals required for the additional circuitry are taken from various pins on the SC/MP chip socket, on the kit PC board. However, there are also three small modifications which must be made to the basic kit board. All three are to ensure that the RAMs and ROM are disabled whenever SC/MP addresses the UART.

One of the three modifications is quite straightforward. It involves cutting the link provided in the PCB pattern between pads J3 and J4, adjacent to pin 1 of the DM81LS95 data buffer IC. A wire is then added to the board so that it connects pin 1 of the IC to pin 36 of the SC/MP socket. This causes the data buffer to be disabled whenever address bit AD11 is high, corresponding to the UART being addressed.

The other two modifications are similar, but a little more tricky in the mechanical sense. The PCB copper pattern on the kit normally earths pin 19 of both MM2101 RAMs, but the translator uses these pins to prevent the RAMs from writing when the UART transmitter is addressed. Accordingly the copper laminate should be removed from around the pin 19 hole for both ICs (preferably before the ICs are mounted on the PCB). This allows the pins to be wired as before to pin 36 of the SC/MP socket, so that both RAMs are disabled when the UART is addressed.

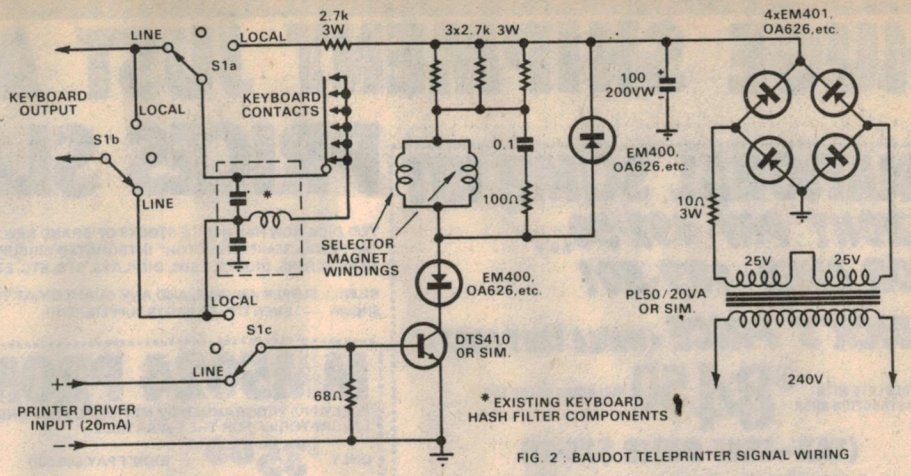

FIG. 2 : BAUDOT TELEPRINTER SIGNAL WIRING

The only other change required to the basic SC/MP kit to convert it into the translator is replacement of the original 512-byte ROM containing "Kitbug", with a pin-compatible EPROM containing the ASCII-Baudot translator program I have written. The EPROM required is the National Semiconductor MM5204, and it may be ordered from the various NS distributors with the translator program resident.

The program is actually "Mark 7", or the seventh version—it took a while to come up with a program which did all the right things at the right times, and would interface to all systems!

Actually I obtained good results with "Mark 4", but it used the reverse interfacing scheme to that shown here—the UART was used for interfacing on the Baudot side, with the SC/MP program performing the ASCII side interfacing. The only problem with this arrangement was that it wasn't capable of receiving an ASCII character while it was sending one; this caused problems when it was connected to computer systems which "echo" keyboard input on a bit-by-bit basis rather than on the more usual whole-character basis. So I finally elected to reverse the system of interfacing, and rewrite the whole program, in order that the translator would be fully compatible with all systems.

The complete final program fits into 512 bytes, including its lookup table of ASCII-Baudot code equivalents. It uses the first six addresses in the SC/MP kit RAMs as a "stack", for storage of counters and pointers, leaving the remaining 250 locations in the RAMs as the character buffer. Since the buffer only accumulates characters according to the difference between the ASCII input and Baudot output rates—i.e., at about 5 characters per second, this gives the translator the capacity to cope with quite respectable character strings.

A complete listing of the program in symbolic form would be far too long to permit publication here. However, I am publishing a full hexadecimal listing, for the benefit of those who may wish to program their own PROMs.

The program itself starts at location 001, which is where SC/MP normally fetches its first instruction upon being powered up. Hence the translator needs no deliberate initialisation by the user—all one does is turn on the power, and away it goes.

Most of the Baudot teleprinters available on the surplus market have printer selector magnets with dual windings, which were intended for either series operation in nominal 20mA loops, or parallel operation in nominal 60mA loops.

The windings have quite high inductance, however, and are not suitable for

Here is complete hex listing of the translator program, resident in an EPROM.

```
0000 08 04 C4 02 35 C4 00 31 C4 00 37 C4 45 33 C4 06
0010 C9 04 C4 07 C9 05 C4 07 C9 06 06 D4 FE 07 C4 40
0020 C9 02 90 24 06 D4 10 98 18 C4 02 36 C1 05 32 C0
0030 CF D4 7F CE 01 A9 05 9C 04 C4 06 C9 05 C4 36 90
0040 02 C4 78 8F 09 3F 90 DC 06 D4 10 98 1A C4 02 36
0050 C1 05 32 C0 AB D4 7F CE 01 A9 05 9C 0A C4 06 C9
0060 05 90 04 C8 9B 90 6C 06 D4 20 9C 67 C4 10 C9 00
0070 C4 00 01 3F 06 D4 20 9C 5A 3F 3F 06 D4 20 98 02
0080 C1 00 01 58 01 C1 00 1C C9 00 9C ED 3F 40 E4 02
0090 9C 04 C4 0D 90 CD 40 E4 08 9C 04 C4 0A 90 C4 40
00A0 E4 04 9C 04 C4 20 90 BB 40 98 B8 E4 1F 9C 04 C9
00B0 01 90 20 40 E4 1B 9C 06 C4 20 C9 01 90 15 C4 01
00C0 36 C4 6E 32 C1 01 58 01 C6 02 98 97 60 9C F9 C2
00D0 FF 90 90 C1 05 03 F9 04 98 7A C4 02 36 C1 04 32
00E0 C2 00 01 40 E4 0D 9C 04 C4 02 90 42 40 E4 0A 9C
00F0 04 C4 08 90 39 40 E4 20 9C 04 C4 04 90 30 40 E4
0100 40 9C 04 C4 2B 90 27 40 98 24 D4 40 E1 02 98 0F
0110 40 D4 40 C9 02 98 04 C4 1F 90 1E C4 1B 90 1A C4
0120 01 36 C4 6F 32 C6 02 98 05 60 9C F9 C2 FD 01 A9
0130 04 9C 07 C4 06 C9 04 90 01 01 06 DC 01 07 C4 10
0140 C9 00 3F 3F 40 D1 00 98 05 06 D4 FE 90 03 06 DC
0150 01 07 90 02 90 10 C1 00 1C C9 00 9C E5 3F 3F 06
0160 D4 FE 07 3F 3F 3F C4 00 36 C4 47 32 3E 08 2D 30
0170 3D 31 39 32 30 33 2A 34 21 35 35 36 3C 37 2C 38
0180 23 39 18 41 13 42 0E 43 12 44 10 45 16 46 0B 47
0190 05 48 0C 49 1A 4A 1E 4B 09 4C 07 4D 06 4E 03 4F
01A0 0D 50 1D 51 0A 52 14 53 01 54 1C 55 0F 56 19 57
01B0 17 58 15 59 11 5A 33 3F 32 24 3E 28 29 29 3A 07
01C0 37 2F 38 2D 2E 3A 2F 3D 31 2B 34 27 27 2E 26 2C
01D0 2B 40 36 25 25 26 32 2A 37 3B 18 61 13 62 0E 63
01E0 12 64 10 65 16 66 0B 67 05 68 0C 69 1A 6A 1E 6B
01F0 09 6C 07 6D 06 6E 03 6F 0D 70 1D 71 0A 72 00 00
```

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4007	Dual complementary pair plus inverter	.30
4009	Hex buffer (inverter)	.90
4011	Quad 2 input NAND	.30
4012	Dual 4 input NAND	.30
4013	Dual D flip flop with reset	.70
4014	8 stage shift register	2.00
4016	Quad bilateral switch	.70
4017	Decade counter/divider	1.80
4018	Presettable divide by N counter	2.00
4021	8 stage static shift register	2.20
4022	Divide by 8 with 8 decimal outputs	1.60
4023	Triple input NAND	.30
4024	7 stage ripple carry binary counter	1.40
4025	Triple 3 input NAND	.30
4027	Dual J-K flip flop	.90
4028	BCD/decimal decoder	1.60
4029	Presettable up/down 4 stage counter	1.80
4030	Quad exclusive OR	.80
4049	Hex buffer/TTL driver inverter	.80
4050	Hex buffer/TTL driver non inverter	.80
4071	Quad 2 input OR	.30
4081	Quad 2 input AND	.30
4416	DPDT switch	.90
4426	Decade counter/7 segment dec/driver	3.20
4449	Economy hex inverter	.30
4511	BCD/7 segment decoder/latch	2.30
4518	Dual BCD up counter	2.00
4520	Dual 4 stage binary up counter	2.00
4528	Dual retriggerable monostable multiv.	1.50
4553	3 Digit BCD counter	7.00
5411	Osc. 16 stage divider with buffer	3.50
74C00	Quad 2 input NAND	.31
74C02	Quad 2 input NOR	.31

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556	Dual timer	1.50
709	Op amp	.50
741	Op amp	.35
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3909	LED flasher	1.10
ZN414	TRF radio chip	3.50
CA3130	FET op amp	1.50
SAK140	Tachometer	1.50
UAA170	Spot-o-light analog to LED display	2.25
UAA180	Bar-o-light analog to LED display	2.40

T~T~L — L~O~W

7400	Quad 2 input positive NAND	.31
7401	Quad 2 input positive NAND with o/c outputs	.31
7402	Quad 2 input positive NOR	.31
7403	Quad 2 input positive NOR with o/c outputs	.31
7404	Hex inverter	.31
7405	Hex inverter with o/c outputs	.31
7408	Quad 2 input positive AND	.31
7409	Quad 2 input positive AND with o/c outputs	.31
7410	Triple 3 input positive NAND	.31
7413	Dual NAND Schmitt trigger	.75
7420	Dual 4 input positive NAND	.31
7430	8 input positive NAND	.31
7437	Quad 2 input positive NAND buffer	.55
7440	Dual 4 input positive NAND buffer	.31
7441	BCD to decimal decoder/driver	1.10
7442	BCD to decimal decoder	.90
7447	BCD to 7 segment dec/driver with 15V outputs	1.25
7450	Expander dual 2 wide 2 input AND OR INV	.31
7451	Dual 2 wide 2 input AND OR INV	.31
7453	Exp. 4 wide 2 input AND OR INV	.31
7454	4 wide 2 input AND OR INV	.31
7460	Dual 4 input expander	.31
7470	Gated J-K flip flop	.45
7472	J-K master slave flip flop	.55
7473	Dual J-K master-slave flip flop	.80
7474	Dual D type edge trig flip flop	.80
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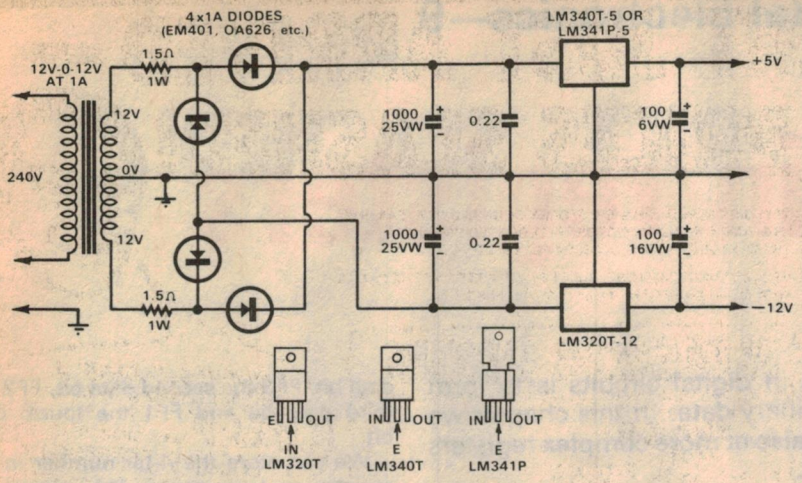

FIG. 3: POWER SUPPLY FOR TRANSLATOR

direct connection into low-voltage circuitry. They should be operated from a substantially constant-current source in order to obtain reliable character decoding. This generally means operating with the windings in parallel, and from a current source employing at least 50 volts. Accordingly a driver transistor must be used, to allow the low-voltage circuitry in the translator to control the magnet current.

Fig. 2 shows the power supply and driver circuit I have built into my machine, a Teletype model 15. It works very well, yet uses only a few easily obtained parts. The driver transistor is a Delco DTS410, but any similar high-voltage medium-power NPN transistor would be suitable. It is operated in switching mode, and does not dissipate significant power.

The circuit of Fig. 2 shows switching which allows the keyboard and printer driver to be connected together for "local" operation, if desired. This is not essential, but I have found it convenient.

Note that the input drive current required by the driver stage is a nominal 20mA, so that it would also be quite suitable for use with solid-state radio-teletype demodulators.

Fig. 3 shows the circuit of a small power supply suitable for the translator itself. It is straightforward, and uses two low-power 3-terminal regulator devices to provide the +5V and -12V supplies required. It would of course be possible to power the translator from the power supply used for the main computer system, if it has the capacity to supply around 400mA at +5V and 250mA at -12V additional to its existing loading.

If your Baudot teleprinter is one of the Teletype machines, you will need a step-down transformer to run its 115V motor from the 240V mains. The motor draws about 1.2 amps, calling for a transformer with a rating around 140VA. A double-wound type is recommended because the insulation of the motor may not be capable of withstanding 240V. I have used a Ferguson Transformer type TS115/125, which although nominally rated at 125VA, runs quite cool even after many hours of continuous operation.

An important point to note if you are using the translator with Teletype machines is that the printing mechanism of these machines is fitted with an optional "down-shift on space" facility. This MUST be disabled for use with the translator, or the translator and printer will get out of step in terms of letters-figures shifting.

On the page teleprinters, models 15 and 19, the facility is controlled by a small horizontal lever at the very bottom of the printer mechanism, right at the front and centrally placed beneath the horizontal selector vanes which convey the character code to the moving type carriage.

To disable the automatic downshift, the keyboard should be removed by undoing the two knurled thumbscrews on each side, and then sliding it out the front. Then using a short screwdriver, loosen the locking screw on the down-shift lever and move its rearward end towards the left until it hits the stop. Finally, tighten the lockscrew again, and replace the keyboard.

On the model 14 typing reperforator the automatic downshift facility is controlled by the position of the vertical selector bar at the extreme left-hand end of the fixed type basket, looking from the front. To disable the downshift, the bar must be moved from the deeper of the two available slots, on the right, to the shallow slot on the left. This prevents it moving when a "space" character is decoded. The bar can be moved by hand; no tools are necessary.

Before closing, there are a few comments which should be made.

If you get the translator going and it seems to make consistent printing errors

```
LOWER CASE (LTRS):  ABCDEFGHIJKLMNOPQRSTUVWXYZ
UPPER CASE (FIGS):  -?:$3%@£# ().,$014'57=2/6+
```

Fig. 4: Both cases of the Baudot character set assumed by the translator program.

with some of the figures-case characters, this will almost certainly be due to your Baudot teleprinter having coding which differs from that assumed by the translator.

This possibility exists because Baudot machines are not all consistent in terms of upper-case characters and coding. Most of the machines available in Australia use the so-called "International Telegraph Code No. 2", and this is the code I have assumed in designing the translator. However you may be unlucky enough to get a machine with different coding, in which case you will get printing errors. They will be consistent, however, so that once you get used to them they should be only a minor irritation.

You can check the coding of your

(continued on page 124)

An Introduction to Digital Electronics—9

Flipflops in registers

Probably the most basic use of flipflops in digital circuits is to form registers, for storing and manipulating binary data. In this chapter we look at basic shift and latch registers, and also at more complex registers capable of performing multiple functions.

by JAMIESON ROWE

As we saw in the preceding chapter, flipflops are capable of storing information. A single flipflop is capable of storing one binary digit or "bit", which is the elementary unit of information. By using a number of flipflops in combination, it is possible to store the same number of bits of information.

By convention, any group of devices used to store and manipulate information is called a "register". Registers may be made up using virtually any sort of information storage device, including such things as mechanical switches and relays. However, most of the registers found in modern digital circuits are formed using flipflops as the storage elements. A group of flipflops used for information storage and manipulation is thus described as a flipflop register.

Probably the most basic type of flipflop register is the shift register. In its simplest form, this consists of a group of D-type flipflops connected as in Fig. 1. As you can see, the clock inputs are all connected together to form a common "clock line", while the Q output of each flipflop is connected to the D input of the flipflop which succeeds it moving to the right.

You will recall, I hope, that upon the arrival of a clock pulse a D-type flipflop adopts the state which makes the logic level at its Q output match the level which was present at its D input. Thus, when a clock pulse is applied to the arrangement shown in Fig. 1, its effect is to cause each flipflop to adopt the state corresponding to the level at its D input.

This means that FF4 will adopt the state previously held by FF3, because its D input connects to the Q output of FF3. Similarly FF3 will adopt the state previously held by FF2, and FF2 will adopt the state previously held by FF1. And FF1 will adopt the state which corresponds to whatever logic level is present at its D input.

In other words, the effect of the clock pulse is to cause the register flipflops to "shuffle" or shift their stored bits of information one place to the right. Hence the name "shift register".

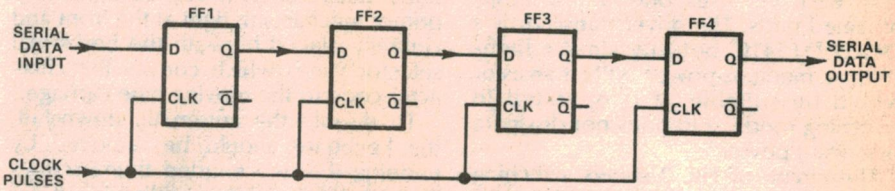

FIG. 1 : BASIC 4-BIT SHIFT REGISTER

It should be fairly obvious that we can feed a 4-bit binary number into such a shift register, by applying its four bits in sequence to the D input of FF1, and applying a clock pulse each time. The first clock pulse will cause the first data bit to be stored in FF1, while the second clock pulse will cause the first data bit to be shift into FF2, and the second data bit to be entered into FF1. Similarly the third clock pulse will cause FF3 to receive the first data bit, FF2 the second data bit, and FF1 the third data bit. Finally the fourth clock pulse will cause FF4 to receive the first data bit, FF3 the second data bit, FF2 the third data bit and FF1 the fourth data bit.

We can store the 4-bit number in the register as long as we like, simply by applying no further clock pulses—assuming we also maintain the flipflop power supply, of course.

When we wish to extract the number from the register, we can shift it out again by applying four more clock pulses. The four data bits will then appear in sequence at the Q output of FF4.

The D input of FF1 thus acts as a serial data input for the register, while the Q output of FF4 acts as a serial data output.

Simple serial-in/serial-out shift registers like that of Fig. 1 are made prepackaged in a variety of sizes, with different numbers of flipflops fabricated in a single IC package. Typical devices have from 4 flipflops as shown, to as many as 4096 flipflops. They are used quite frequently in digital circuits, mainly for binary data storage.

They are also used as time delay elements, by making use of the fact that if binary data is applied to the serial input with continuous clocking, the data bits take an appropriate number of clock pulse periods to shift through the register and reappear at the serial output. For the 4-bit register shown, data will thus take 4 clock periods to shift through the register.

In general terms, a serial-in/serial-out shift register with "N" flipflops (where N is any integral number) may be used to delay binary data by N clock pulse periods.

Fairly obviously, the basic shift register of Fig. 1 is only capable of shifting data in one direction. At times, it can be very desirable to have a register capable of shifting data in either direction. For these applications a slightly more complex shift register is used, with logic gates to allow control of the shifting direction. This is illustrated in Fig. 2.

Basically the gating allows the D input

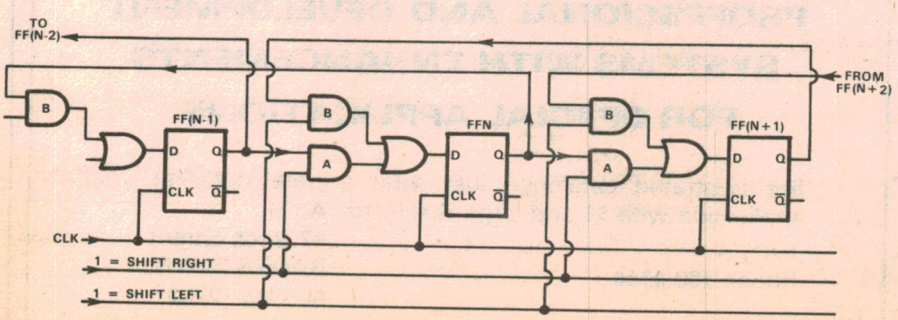

FIG. 2 : SECTION OF A BIDIRECTIONAL SHIFT REGISTER

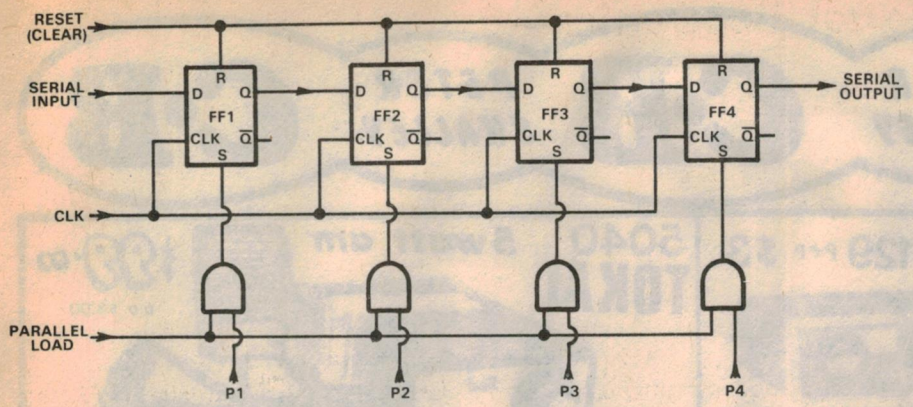

FIG. 3 : 4-BIT SHIFT REGISTER WITH CLEAR AND PARALLEL LOADING

of each FF in the register to be connected either to the Q output of its neighbour to the left, as before (via the AND gates marked "A"), or to the Q output of its neighbour to the right (via the AND gates marked "B"). The two AND gates associated with each input connect to it via an OR gate, as shown.

The control inputs of all the "A" AND gates are connected together, as shown, as are the control inputs of the "B" AND gates. Thus by applying a logical 1 to the control line for the "A" gates, the register can be set up for shifting data to the right. Alternatively a logical 1 can be applied to the control line for the "B" gates, and this will set up the register for left shifting.

It would be usual to label the "A" gate control line as a "shift right enable" line, signifying that its function is to enable the shift right capability of the register. Similarly the "B" gate control line would be labelled "shift left enable".

In the shift registers of Figs. 1 and 2, the only way of getting data into the register is serially—ie., one bit at a time. This can be too slow in many applications, and accordingly many registers are provided with a facility to load data in parallel fashion (all bits simultaneously). One way of doing this is shown in Fig.3.

Each flipflop of the register is provided with direct set or S inputs, as you can see, and each S input is fed by an AND gate. One of the two inputs of each AND gate is connected to a common control line, while the remaining inputs are kept separate and become the parallel inputs of the register—P1, P2, P3 and P4.

To load the data present at the parallel inputs into the register, a short enabling pulse is applied to the gate control line (in other words, the line is taken briefly to the logic 1 level). Those gates whose data inputs are at logic 1 level will therefore be enabled, and their outputs will accordingly go to logic 1 level also. This will cause their associated FFs to be forced into the set state, if they were not previously in that state. If they were already in the set state, they will remain there. Either way, the logic 1's present at the data inputs effectively will have been loaded into the FFs.

Note, however, that when the gate control line is pulsed, only those gates whose data inputs are at logic 1 level will be enabled. The other gates will not be enabled, because their data inputs will be at logic 0. As a result the flipflops associated with these gates will not be affected—even if they happen to be set to a 1, which is the exact opposite of the data bit we are trying to load in.

Because of this problem, the flipflops of Fig.3 are provided with direct reset or "clear" inputs as well, and these are connected together to form a common reset or clear line. This is used to reset all of the FFs together, before the actual parallel loading is performed.

This means that just before the input gate control line is pulsed, all of the flipflops in the register are forced into the reset state, wherein they contain 0's. Hence when the gate control line is pulsed and the gates whose data inputs are at logical 1 level force their associated FFs into the set state, the remaining FFs will all remain in the reset state—effectively storing the 0's present at the data inputs of their gates, even though these gates actually remain inactive.

So that with a register provided with the simple type of parallel data loading scheme shown in Fig.3, parallel loading actually becomes a two-step process. First the reset or clear line is pulsed, to clear the register, and then the parallel load enable line is pulsed to allow the input gates to enter the "1" data bits as appropriate.

While this form of parallel data loading is adequate for many purposes, there are situations where the required two-step process can be inconvenient. There are also other situations where it is required to perform parallel loading of data synchronously—ie., in step with the system clock pulses.

To cope with such situations, another type of parallel data input loading can be used. This is known as "jam transfer", and as the name suggests it allows parallel data to be jammed into the register flipflops regardless of the data bit values or the previous states of the flipflops. And the transfer takes place in response to a normal clock pulse, so that it meets the synchronism requirement.

One way of achieving jam transfer parallel loading is shown in Fig.4. As you can see the D input of each FF is provided with a gating system rather like that of Fig.2, with two AND gates feeding each input via an OR gate. And as before, the "A" gates are used to connect the D inputs to the Q-output of the preceding FF (or the serial input, in the case of FF1), for right shifting.

Here the other set of AND gates (labelled "B") are used not to set up the data paths for left shifting, but to enter the parallel data. The data input of each gate becomes the parallel input for its associated flipflop. So that when a clock pulse is applied to the register clock line, data bits from the parallel inputs P1, P2, P3 . . . will be forced into the flipflops if the "B" gates have been enabled by a logic 1 level applied to their control inputs.

Note that this will be a true jam transfer, because when a D-type FF is clocked, it is forced to adopt the state corresponding to the logic level present at its D input. In other words, we have a jam transfer here because a flipflop D input is active at both logic levels, whereas the S inputs used in Fig.3 are active only when taken to the true logic level.

Quite incidentally, Fig.4 shows the control lines for the two sets of gates interconnected via an inverter. This is a technique often used, with the idea of reducing the number of separate control signals required to control register operation. With the scheme shown, a logic 1 level applied to the "Mode" input causes the "A" gates to be enabled, so that the register performs the shift right operation. However if the logic level at the Mode input is changed to an 0. this not only dis-

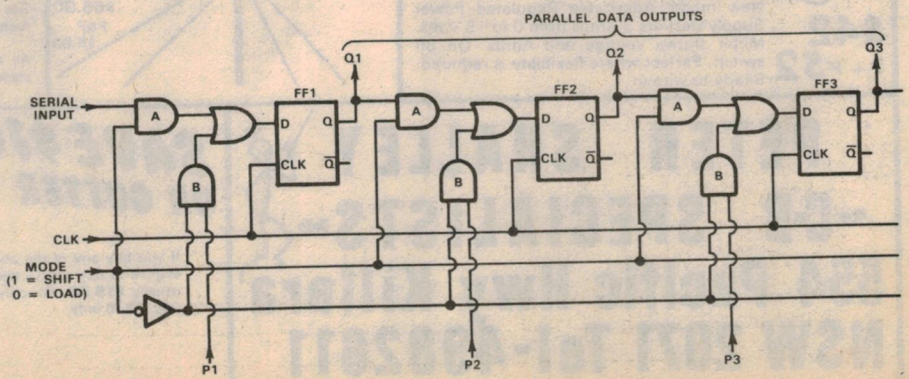

FIG. 4 SECTION OF A SHIFT REGISTER WITH JAM-TRANSFER PARALLEL LOADING

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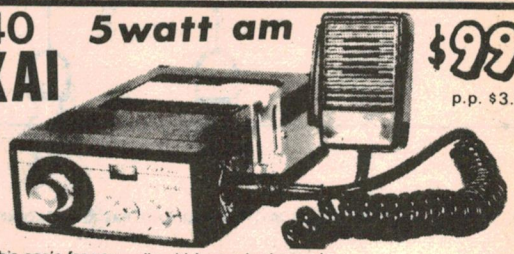

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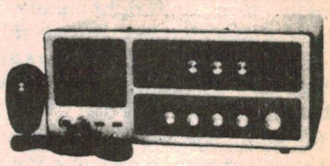

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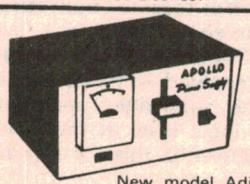

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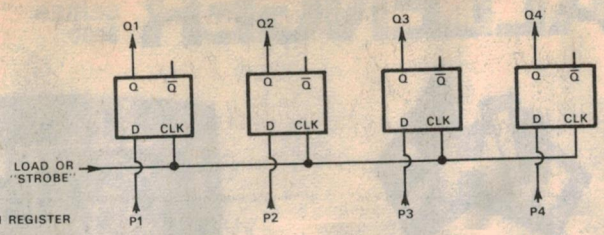

FIG. 5 : 4-BIT LATCH REGISTER

ables the "A" gates but also enables the "B" gates via the inverter—so that the register performs the parallel loading operation. A single control signal is thus able to determine the register's mode of operation.

The flipflops in Fig.4 are also shown with their Q outputs brought out, with labels Q1, Q2, Q3, etc. This is done with some shift registers, as it allows a further degree of flexibility: data bits can be taken from the register in parallel, as well as being loaded in parallel.

One important use for registers fitted with parallel data inputs or outputs is serial-parallel and parallel-serial conversion. For example, a binary number available only in parallel form may be converted into serial form by loading it into a register via the parallel inputs, and then shifting it out bit by bit.

Conversely a binary number available only in serial form may be converted into parallel form by shifting it into a register via the serial input, and then sensing the bits simultaneously at the parallel outputs.

Some pre-packaged flipflop registers are provided with parallel inputs and a serial output, expressly for parallel-to-serial conversion. Others are provided with parallel outputs and a serial input, expressly for serial-to-parallel conversion.

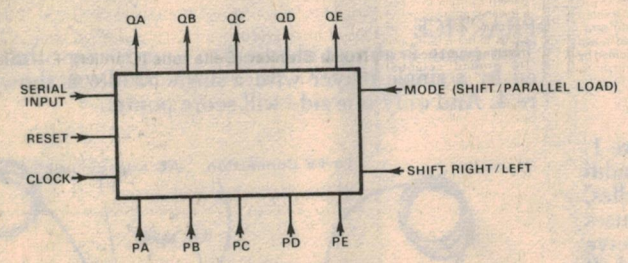

FIG. 7 : MULTI-PURPOSE 5-BIT REGISTER

Still others are provided with all of these, and are therefore capable of performing both types of conversion quite apart from pure shifting and data storage.

Not all flipflop registers are shift registers, though. In fact one simple type of register quite often encountered is the latch register, which is used purely for parallel data storage. As you can see from Fig.5, it consists essentially of nothing more than a row of D-type flipflops with their clock inputs connected together. A clock pulse applied to the common clock line effectively causes each FF to load in the data bit present at its D input, so that the D inputs become the parallel data inputs of the register and the clock line becomes a "load", "store" or "strobe" control line.

While Fig.5 shows a latch register for only four bits, pre-packaged latch register ICs are available which provide for up to eight or ten bits. And of course longer latch registers may be assembled if required, using multiple devices. This also applies to registers of the type shown in Figs. 3 and 4.

The registers we have looked at so far in this chapter have been only capable of shifting data right or left, parallel loading, or clearing. While these are the operations most commonly performed by registers, other operations are at times required, and accordingly some registers are provided with the appropriate facilities.

One such facility is the ability to complement the stored data bits—in other words, each FF of the register may be toggled to its opposite state. This can be of value where a register is used for binary arithmetic, as we will see later on.

To provide such a bit complementing facility, gating is provided so that application of a suitable control signal causes a data path to be opened up between the D input of each FF and its own Q-bar output. A clock pulser then causes each FF to adopt the state formerly present at its Q-bar output—ie., it toggles.

Another facility which may be provided is the ability to "rotate" the bits of the stored data, either to the right or the left. This is similar to shifting, except that a data path is opened between the FFs at the two ends of the register so that none of the bits are "lost".

To rotate data to the right, for example, the Q output of the FF at the right-hand end of the register is connected via gating to the D input of the FF at the left-hand end, while all of the other D inputs are connected as in Fig.1 for right shifting. A clock pulse then causes all of the data bits to be shifted to the right, except for the rightmost bit which is rotated back into the leftmost FF.

Similarly, by using gating to connect the D input of the rightmost FF of a register to Q output of the leftmost FF, in addition to connecting all the other data paths for left shifting, it becomes possible to perform a "rotate left" function.

Other facilities which may be provided on registers include parallel logic functions such as AND, OR, and exclusive-OR. These are found somewhat less frequently, but have important uses in data processing. Broadly speaking they are provided rather like jam-transfer parallel loading, except that additional gating is used to provide the required logic.

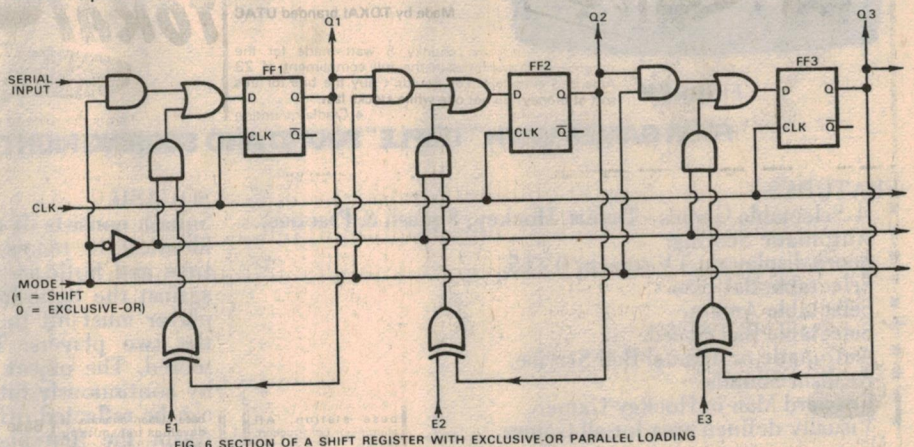

FIG. 6 SECTION OF A SHIFT REGISTER WITH EXCLUSIVE-OR PARALLEL LOADING

This is illustrated in Fig.6, which shows a basic shift-right register provided with an alternative exclusive-OR facility. As you can see, it is broadly similar to Fig.4. The difference is that instead of being directly applied to the D inputs of the FFs when the Mode line is taken to logic O, the parallel data inputs are fed via exclusive-OR gates where they are compared with the existing data bits in the FFs. This is done by connecting one input of the ex-OR gates to the FF Q outputs.

When registers are implemented using single ICs, it is not usual to show all of the internal FFs and gating on a logic diagram. Thus a single-IC register of 5-bit capacity may be shown by a symbol like that in Fig.7, with a simple rectangle representing the register as a whole. All that is shown are the various control signal inputs, together with the data inputs and outputs. This is generally quite adequate for design purposes, providing the functions of the various inputs and outputs are clearly defined.

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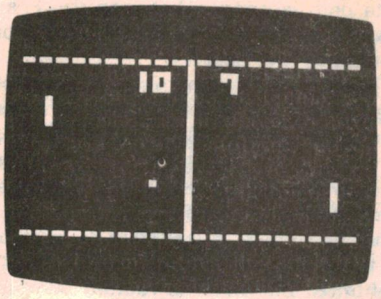
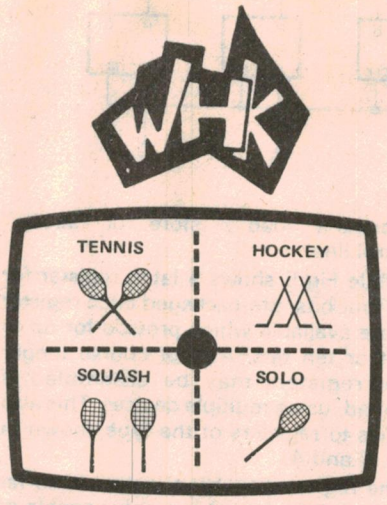


FIGURE 1



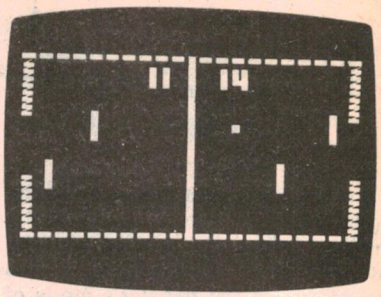


FIGURE 2

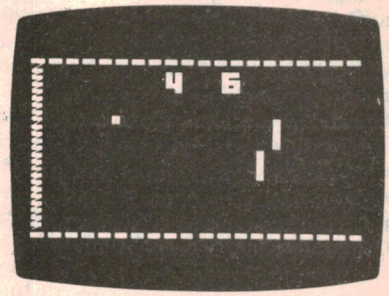


FIGURE 3

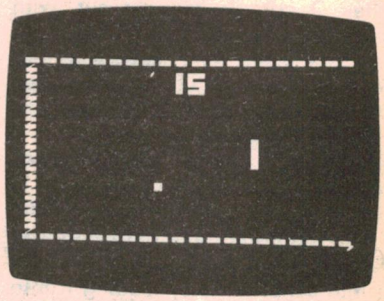


FIGURE 4

FOUR GAMES WITH "TRIPLE" SOUND AND SCORING RIGHT ON YOUR TV SCREEN.

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* Selectable Ball Speed.
* Automatic or Manual Ball Service.
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* Forward Man in Hockey Game.
* Visually defined area for all Games.

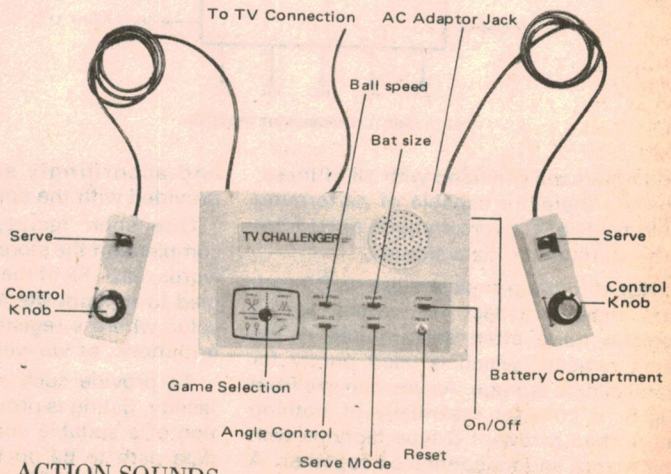
GAME DESCRIPTION

TENNIS
The game will appear on your screen as shown on figure 1. It is played by the players who use the left and right paddle controllers to vertically raise or lower their paddles. Play starts upon depressing the reset switch which causes the score to reset to 0 - 0 and when the manual serve switch is in the automatic position will serve the ball from either the left or the right court. The player who is served must hit the ball back to his opponent, who must then return it. When either player misses his shot, a point is scored for his opponent and the next ball is served to him from the opponents court. Scoring is automatically displayed. The game ends with the first player to reach 15 points.

HOCKEY
This game will appear on your screen as shown on figure 2. Hockey, while similar to tennis, is a much faster and more exciting game. Each player controls his GOALIE who moves in a vertical motion, and one forward MAN who also moves vertically. These MEN move up and down as a group. As in tennis, the opening serve comes cross-court to either player on a random basis. Further serves are to player who has just lost a point. Since each player has two MEN who can return the puck, the play is very fast. Scoring is the same as in tennis - first player to reach 15 points is the winner.

SQUASH
Squash consists of a court as depicted in figure 3. It plays identical to tennis except only one player operates at a time and both are on the same side of the court, playing against the opposite wall. After the ball is served the left player must hit the ball first and then alternates between the two players. This action continues until a point is scored. The object of the game is to keep the ball in play by continuously hitting it to the back court wall. The ball can be reflected off 3 sides - the top, botton, and left wall. Again the first player to score 15 points is the winner

PRACTICE
This game is almost identical to squash exept that it is played by a single player with a single paddle as shown on figure 4. And only one side will score points.



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b) When the ball hits a paddle.
c) When a score is made.

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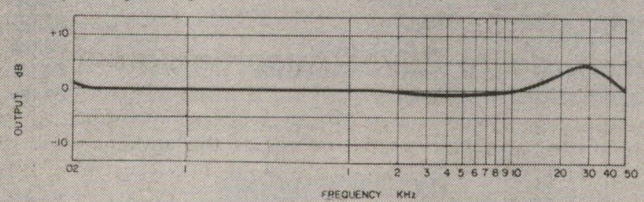

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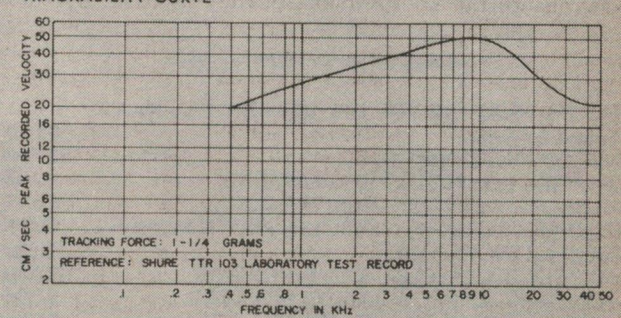

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Classical Recordings

Reviewed by Julian Russell

Strauss—An Alpine Symphony

STRAUSS — An Alpine Symphony. The Los Angeles Philharmonic Orchestra conducted by Zubin Mehta. Decca Stereo SXLA 6752.

Geoffrey Crankshaw, who wrote the sleeve notes for this work, displays unusual enthusiasm for what is generally regarded as second-rate Strauss. He writes that Strauss uses "an unusual range of instruments to depict a wide range of natural phenomena, yet is also profoundly human, setting personal endeavours in a universal enviroment."

There can be no disagreement with the first part of this statement. The Alpine Symphony is scored for no fewer than 20 horns, quadruple woodwind, six trumpets, six trombones, a great variety of percussion of different materials and, of course, enough strings to balance this formidable ensemble. Some of the brass play off-stage but, in the hall, Strauss adds a wind machine, a thunder sheet and various other paramusical devices.

Admittedly Strauss could make an orchestra produce sounds that describe with uncanny realism objects not usually associated with music. Indeed he himself claimed to be able to describe a glass of beer in musical terms. Even in pre-inflation days the cost of assembling such a congregation put a performance of The Alpine Symphony beyond the ordinary resources of concert managements, so that a live performance has always been a rare occasion.

But I think the second part of Crankshaw's statement must be accepted with more reserve. Strauss personally was not a sensitive man though, surprisingly, he had a great gift for musical characterisation, not only in his vast output of operas but also in orchestral works. But not even his greatest admirers — and I include myself in this category — could call him noble. He was often boorish and his ideals of personal endeavour were never quite as lofty as Crankshaw claims, but were very much more bourgeois.

At his greatest he was an unquestionable genius, although not in this work which describes almost step by step the ascent and descent of a mountain with many of its attendant hazards. True he achieves the purely descriptive elements with unmatched realism. But nobility of human endeavour were not in his otherwise wide range of expression.

Also Sprach Zarathustra can in no way, except perhaps its now hackneyed mighty first theme, be compared to his brilliant Till Eulenspiegel, the latter an inspired portrait of a mischievous imp who would be the last to claim nobility of character. In An Alpine Symphony, when Strauss seeks to express nobility, he becomes more than usually rhetorical.

But despite all the objections I have set down — and some might well call them prejudices — this disc is still very worth while owning. It has beautiful moments and some exciting ones, too, and Mehta misses no opportunity of communicating them in a recording of great tonal splendour, faultlessly engineered. Despite the often extreme complexity of the score there is no crowding of the numerous strands.

In the same way as few can remain unmoved by the majesty of the Alps, the symphony has a similar appeal in parts. Although Strauss was fully mature when he composed it there are constant reminiscences of Wagner's and Strauss' own earlier works. For instance the Rosenkavalier is never completely forgotten. But it's all echt-Strauss with its wide ranging melodies modulating characteristically from key to remote key. And there are passages as exquisitely delicate as any he ever wrote.

The music is very much of the "program" variety and if you follow Crankshaw's notes on this aspect the various activities are very easy to follow. Strauss describes them with undeniable ingenuity. You can actually "hear" the party losing its way. But all this is, to me, marred by a bagful of tricks that he had used often before, and there is something faded about many of his romantic melodies. Some even sound a little second hand.

I don't know if Mehta used all the instruments and other devices that the score demands but he gives a grand reading, spacious on most occasions, and sensitively understanding on others. Strauss is quoted as saying that it was his finest work. Yet when the Americans occupied Bavaria towards the end of the last war an American scouting squadron looking for barracks spotted a grand villa, on a hill overlooking Garmisch-Partenkirchen, in which Strauss lived. This, they thought, is it. But when they arrived there they were greeted at the door by an old gentleman who said simply, to the captain in charge: "I am the composer of Rosenkavalier". He was left undisturbed. The composer of An Alpine Symphony would have meant nothing to soldiers.

Jean Martinon conducts Ravel—recommended

RAVEL — Bolero; Scheherazade Overture; Rapsodie Espagnole; and La Valse. Played by the Orchestre de Paris conducted by Jean Martinon. HMV Stereo/Quadraphonic OASD 3215.

I saw a lot of Jean Martinon, who died last March, when he came out here for an Australian tour some years ago. During my many conversations with him he usually finished up by introducing the subject of rhythm in orchestral playing, insisting that it was one of its most important features. He communicated this opinion to many of the orchestras he conducted here, with highly satisfactory results.

In this splendid disc you will hear the effects of this — one could even call it an obsession — on the Orchestre de Paris which, after a rather shaky start a few years ago, has now developed into a very good combination indeed, especially in the playing of French music.

Martinon starts his concert on this fine new issue with Ravel's Bolero, a work which of course, relies almost entirely on rhythmic treatment to be heard at its most effective. Bolero is a subtle attack on the nerves of the audience with its seemingly endless repetition of the same tune and tempo, differently scored each time it is heard and gradually increasing in volume towards its final exciting climax. It is interesting to compare it to modern pop music that often essays the same thing but which usually achieves nothing but mindless repetitious banality.

The string tone is not as voluptuous as that of some other first class orchestras but I am not sure that this is very important in a piece like Bolero. The rest of the orchestra plays superbly without ever missing a breath, so to speak. You have probably heard Bolero countless times, as I have, but this should not spoil your enjoyment of this magnificent achievement.

The second item is what Ravel described as a Fairy Overture to his unfinished opera Scheherazade. It is a student work and like so many other student adventures is powerfully influenced by the music of previous composers.Yet it already shows traces of the

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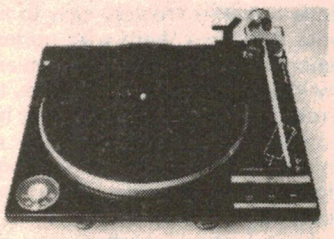

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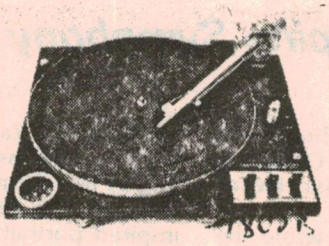

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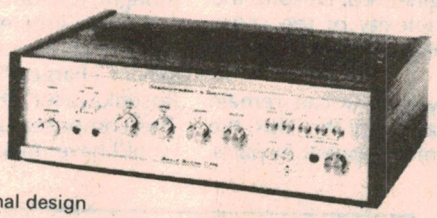

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composer's own inimitable style and is well worth its inclusion despite its lack of formal security. Its main interest is to be found in its prophecy of Ravel's superb gift for orchestration. By the way, in this piece the strings play with a much more voluptuous tone than in Bolero.

Next comes Ravel's first really mature big orchestral work, Rapsodie Espagnole, a piece exquisite in conception, and on this disc in execution too. I will stake my reputation on the statement that under Martinon it is easily the finest recording of the work I have ever heard, and I cannot count the number of times I have heard it played by different orchestras and conductors over many years.

You will hear quite wonderful rhythmic treatment in the Malaguena and just as fine, though different, Havanera. And again, the same pulse quickening handling of the final Feria.

The concert ends with La Valse, starting in mysterious darkness and finishing in near blinding incandescence. If you love the best of French music as much as I do please don't miss this disc. By the way I listened to this compatible stereo/quadraphonic disc on stereo equipment with the happiest of results. I am happy to be able to say that this extravagant pocket raider has proved a disaster to its manufacturers and the four-channel repertoire is as scanty as a bikini.

★ ★ ★

RACHMANINOV – Rhapsody on a Theme by Paganini for Piano and Orchestra.

DOHNANYI – Variations on a Nursery Song for Piano and Orchestra. Cristina Ortiz (piano) and the New Philharmonic Orchestra conducted by Kazuhiro Koizumi. EMI Stereo/Quadraphonic OASD 3197.

Here is a thoroughly workmanlike performance by soloist and orchestra of the Paganini, a piece chosen so often by hopeful competitors in piano competitions. Wherever possible the tempos are brisk though there is a tendency to slow down the contrasting sequences a little too much. The engineering is spacious with a wide but not overpowering dynamic range.

Unfortunately there is no information about the conductor who I take to be Japanese, and a highly competent director. The same applies to the brilliant soloist except for a coloured photograph on the face of the sleeve of a very personable young woman.

The Dohnanyi Variations have long been a favourite of mine though I haven't heard them for many years. It is a consistently witty work using many of the variations as parodies of various musical forms. It begins with an immensely pompous introduction which strains to lay a pigeon-sized egg – the theme which corresponds closely to our well-known nursery rhyme, Baa, Baa Blacksheep.

The eleven variations and fugal Finale are full of surprises, all with easily recognisable relationship to the original theme. As in the Rachmaninov noted above the slower portions of the score seem to me just a little too retarded, but otherwise the performance by both soloist and orchestra is admirable. There is, however, a particular obtrusive and nasty toned piccolo solo in the item preceding the music box variation.

Here are two works for piano and orchestra set down by composers who knew how to write a virtuoso part for the solo instrument without adding unnecessary showy padding. Enthusiastically recommended. I played this, too, on stereo equipment with excellent results.

★ ★ ★

DVORAK – Piano Concerto in G Minor. Justus Frantz (piano) with the New York Philharmonic Orchestra conducted by Leonard Bernstein. CBS Stereo SBR235779.

As the sleeve notes state you will hear in this early effort by a great composer much varied and attractive material though not always treated with the formal resources of his later works. Bernstein, as might have been expected, starts off with a nervously tense introduction before the piano enters. Dvorak himself was not much of a pianist though he performed better on the violin, and the piano writing here is nowhere nearly up to the standard of treatment of the cello part in his great concerto for that instrument.

Conductor Leonard Bernstein.

Throughout the Piano Concerto some of the themes are just plain banal as is their working out which is only too easily predictable, but here and there you come across a real Dvorjakian melody that quickly jolts the listener's interest back. The piano tone is often a little shallow though the soloist's technique is satisfactorily fluent.

I can't imagine the concerto ever becoming popular, even with a visual accompaniment of Bernstein's balletic improvisations on the rostrum. Philip Ramey, who wrote the accompanying sleeve notes, seems to have included as many pejorative – but amusing – criticisms of the music as he could. I'm afraid I cannot welcome this new issue with any great enthusiasm.

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Lighter Side

Reviews of other recordings

Devotional and organ

THE ARCHERS. Things We Deeply Feel. Stereo, Light, LS-5679-LP. (From Sacred Productions Australia, 181 Clarence St, Sydney and other capitals).

The jacket notes introduce the Archers as a group of seven young people, presumably with the backing here of a dozen extra musicians playing keyboards, Moog, guitar, steel guitar, drums, percussion, electric fiddle, and so on. With their own special arrangements, and with the support of Ralph Carmichael, it's all very professional, as further evidenced by the fact that the group have toured the USA, Canada, and Europe and are under professional management sited on Sunset Boulevarde. And that's the talent they bring to bear on eleven modern rock style Gospel songs:

Music – Giver Of Life – Sit Yourself Down – Lord, You've Been Good To Me – It Wouldn't Be Enough – I'm With Jesus – Brand New Day – You Are My Inspiration – If You Can't Believe In Love – It's Love To Me – Praise Him.

Recorded in Hollywood, I doubt that there's a note out of place in the whole performance, which plays for about 37 minutes. It's a performance by youth for youth, and for others who like soft rock and mod. style Gospel vocals. In short, another one for after-church youth groups—and groupers. (W.N.W.)

★ ★ ★

MY SAVIOUR FIRST OF ALL. Rudy Attwood. Stereo, Word WST-8603-LP. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals).

Rudy Attwood, well known some years ago as the pianist for "The Old Fashioned Revival Hour" is just as likely to refer to himself, these days, as "the last of the squares". And certainly, the man who was once regarded as an exponent of tasteful Gospel music ornamentation, sounds more than usually restrained on this album.

But, if you like the old hymn tunes for their own sake you might easily find his unhurried playing very restful: When Morning Gilds The Skies – O Jesus I Have Promised – He Lifted Me – What A Friend We Have In Jesus – Only Jesus – The Glory Of His Presence – My Saviour First Of All – Ivory Palaces – Why Should He Love Me So – Sitting At The Feet Of Jesus – Does Jesus Care?

Rudy Attwood may indeed be rated as a "square" but his phrasing is impeccable and those who have enjoyed "The Old Fashioned Gospel Hour" through the years could find his latest album enjoyable and restful. (W.N.W.)

★ ★ ★

DIE NEUE ARCO ORGEL IM MOZARTEUM ZU SALZBURG. Various organists. Stereo/mono compatible, Pelca PSR-40 539. (From Crest Record Co, 122 Chapel St, St Kilda, Vic 3182).

If I could read the jacket notes for this imported German recording, I would run less risk of saying the wrong thing. However, I gather that it is one of the Pelca label's "Organ Profile" series and is devoted to the new organ in the Great Hall of Mozarteum in Salzburg. Constructed by Professor Wolfgang von Karajan and by Prof. Oscar Peter in its latter stages, the organ is a magnificent 4-manual instrument which, while satisfying traditional requirements, has nevertheless been designed to offer the greatest possible versatility—as required by the academic staff and by advanced students of the Mozarteum.

In keeping with the "organ profile" theme, the jacket notes deal mainly with the instrument, ending with its specifications—and what a range they reveal, from multiple 32ft stops on the pedals, to 1ft on the positive manual, plus a variety of mixtures and fractionals, seven coupling modes, tremulants on every manual, and whatever else there might be which I failed to work out from the notes!

And the obvious purpose of this album is to reveal the versatility of the organ, its sharpness when required, its attack and clarity and its massive power—all well captured by the recording.

But, let me sound a warning: if you're expecting traditional organ recital music, you're doomed to disappointment.

Item 1, "Transition" (George Pirckmayer) played by Herbert Tachezi, has a modern, almost atonal quality.

Item 2, "Ornamente, Partita fur Orgel" played by Ernst Leitner is somewhat more conventional and displays the organ to advantage, but . . .

Item 3 "Signum fur Orgel" (Gerhard Wimberger) played by Stefan Klinda, is really "way out" and could be transported bodily to the sound track of a science fiction horror film.

Item 4 "Hosanna Filio David" (Cesar Bresgen), also played by Klinda confirms the more traditional scope established by Item 2.

It's an album that should intrigue the classical organ buff but it's scarcely one that will endear him/her to other members of the household—or neighbours if played at the volume level it invites! (W.N.W.)

Instrumental, Vocal and Humour

CARISSIMA. Barenboim conducts Elgar with the English Chamber Orchestra. CBS stereo SBR 235774.

Elgar's music is difficult for many people to appreciate. Its often delicate introspection is often ruined by conductors so that it becomes morbid. Daniel Barenboim succeeds better than most in preserving the true character of the music but still needs to be listened to carefully to be fully appreciated. This record contains both popular and less well-known Elgar compositions and is a good acquisition for those requiring an introduction to this composer. Recording quality is good.

Compositions featured on this disc are: Salut D'Amour – Romance For Bassoon And Orchestra – Rosemary – Carissima – Sospiri, Op 70 – Chanson De Matin, Op 15 No 1 – Chanson De Nuit, Op 15 No 2 – Elegy for Strings, Op 58 – Serenade In E Minor For Strings, Op 20. (L.D.S.)

★ ★ ★

ROBERT STOLZ CONDUCTS JOHANN STRAUSS. Wiener Symphoniker. Somerset (Astor) stereo MWC 1007.

At its worst, the music of Johann Strauss can be awfully hackneyed. At its best, it can be charming. This collection falls into the latter category, fortunately. Little more need be said about apart from the comment that the recording quality is good.

Tracks featured are: Die Fledermaus Overture – Annen Polka – 1001 Nights Intermezzo – Radetzky March – Kaiser Waltz – Unter Donner Und Blitz – Gypsy Baron Overture – Tritsch Tratsch Polka. (L.D.S.)

Reviews in this section are by Neville Williams (W.N.W.), J. Rowe (J.R.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.) and David Edwards (D.W.E.).

LIGHTER SIDE: Popular cassettes

VIENNA, CITY OF MY DREAMS. Richard Tucker, the Columbia Symphony Orchestra conducted by Franz Allers. Stereo cassette, Harmony (CBS) HMC-545.

Pictured in formal attire, complete with top hat, and backed here by the Columbia Symphony Orchestra, Richard Tucker is very much the traditional dramatic tenor. But don't let that put you off, if it's likely to: his program is eminently listenable and a welcome change for ears that may have had more than a fair dose of TV style vocalists:

Vienna, My City Of Dreams – I Have Been In Love Before – Medley from "Boccaccio" – Roses From Tyrol – Lovesong Of May – Frasquita's Serenade – Yours Is My Heart Alone – Medley For "The Count Of Luxembourg" – In Our Secluded Rendez Vous – Love You Invaded My Senses – Wonderful World – Darling, Trust In Me – I Long For Vienna.

The more I listened to Richard Tucker, the more I felt that he would be a change also from the usual fare one tends to envisage for the car stereo player! Quality is generally good and this is one I must recommend. (W.N.W.)

★ ★ ★

THE GLITTERING LIBERACE. Harmony stereo cassette (CBS) HC-1135.

The Liberace who smiles back at you from this particular cassette pack looks to be a much younger man than the one I watched on television recently! I fancy that the program is also "vintage" Liberace, typical highly ornamented piano plus orchestra, done without audience, and punctuated by a couple of vocals in his better-than-average bathroom baritone:

Cornish Rhapsody – Traumerei – Lieberstraum – Gershwin Medley – Sonata No 9 – Concerto In B-Flat Minor – Rhapsody In Blue – Sincerely Yours – El Cumbanchero – Minuet In G – Tea For Two – Polonaise In A-Flat – Beer Barrel Polka.

In terms of quality, I was conscious of vague wow effects here and there but, overall, the sound is adequate for casual, or background listening, or for use in the family car. (W.N.W.)

★ ★ ★

HOLIDAY WITH JAMES, the Sid Sidney Orchestra. Contata cassette, Dolby stereo A-113. (From Goldring Sales & Service in all capitals.)

Make of it what you like – James Last or James "Harry" – but what you actually get is a string of medleys played by the Sid Sidney Orchestra, plus chorus, plus an audience that claps and talks and carries on in a "we're really enjoying it" manner. I doubt that many people would consciously select this one to play in the home but it would probably come off much better in the family car on holiday!

There are far too many titles to permit them being listed here but a few that catch the eye include: Delilah – What Now My Love – Puppet On The String – Strangers In The Night – Love Is Blue – What A Wonderful World – Cielita Lindo – La Cucaracha.

Quality is average but adequate for a tape which mainly seeks to put you alongside a big band and an audience having fun. (W.N.W.)

SPRINGTIME IN MOSCOW. The Violins of the Bolshoi Theatre conducted by Yule Reyentovitch. HMV Melodiya Concert Classics, stereo SOXLP-30188.

This album of "favourite music" was recorded in the USSR at various times between 1963 and 1968. The choice of familiar, tuneful snippets, the preponderance of strings and the completely unhurried playing would suggest that there is an audience in the USSR also which likes to be soothed during the late evening:

Moto Perpetuo, Op 11 (Paganini) – Humoresque Op 101 No 7 (Dvorak) – Largo (Handel) – Melodie from "Orpheus and Eurydixe" (Gluck) – Poem Op 41 No 14 (Fibich) – Variations On A Theme Of Corelli (Kriesler) – Meditation From "Thais" (Massenet) – Melody In F (Rubenstein) – Vocalise Op 34 No 14 (Rachmaninov) – Valse Triste From "Kuolema" (Sibelius) – Romance From "The Gadfly" (Shostakovitch) – Perpetuum Mobile (Novacek).

Because of their age and lack of ambience, in some cases, the recordings are not noteworthy for their quality but, heard as a gentle background, the sound is adequate and many could find it thoroughly relaxing and enjoyable. Generous background notes are provided by W. A. Chislett. (W.N.W.)

★ ★ ★

LOS REALES DEL PARAGUAY. The South American Way. Astor stereo GGS 1486.

Combine a Paraguayan harp, two guitars plus assorted percussion and Hammond organ plus the zesty voices of the "Kings of Paraguay" and you have the ingredients for some of the brightest Latin-American music ever produced. Recording quality is very good.

There are twelve tracks in all: Llevame Contigo (Take Me With You) – Numa 1 – Y Viva Espana – Yo Vendo Onos Ojos Negros – Centavos Y Pesetas – Vaya Con Dios – Aquellos Ojos Verdes (Green Eyes) – Alla En El Rancho Grande La Bamba – Na Juana – La Paloma – Que Sera – Hasta La Vista. (L.D.S.)

THE AMAZING BAVARIAN STOMPERS. Stereo, Astor Golden Hour GH 597.

If your musical fancy runs to oompah-pah German bands this hour long record of medley style tracks of mainly non Bavarian music may be worth an audition. The sound quality is reasonable, considering the amount of dynamic compression that must take place to cram 30 minutes on each side, there being over 40 titles under 16 headings.

Some of these are: Happy Wanderer – Wooden Heart – Der Treue Husar – Daisy Bell – My Bonny Lies Over The Ocean – Liechtensteiner Polka – Tavern In The Town – Little Brown Jug – Colonel Bogey – So Leben Wir – In Munchen Steht Ein Hofbrauhaus – Liberty Bell – Nach Tausen – Life On The Ocean Wave – Rule Britannia. A party sing-along starter would be a good description. (N.J.M.)

QUADRAPHONIC ALBUMS

TUBULAR BELLS. Mike Oldfield. QS matrix quadraphonic, Virgin (Festival) L-35127.

Entering the rock music scene at the age of 14, Mike Oldfield first played in a family group, then formed "Barefeet" which lasted a mere two years, and landed him back into routine session work. At 17 he began to develop the idea of his first major composition–"Tubular Bells"–a full orchestral work which he was to do virtually alone, by means of overdubbing. His first effort, made with a 4-track recorder, aroused interest, but that was all. So he did it all again with better equipment and, just when it seemed like bombing out, "Tubular Bells" suddenly took off and raced to the top of the charts with sales of around five million.

Described somewhere as "symphonic rock", the mood of the first side is relatively subdued–a reflection, presumably, of Oldfield's natural reserve at the time, and his tendency to escape into a tranquil world with the very guitar that at other times would belt out solid rock.

But the tranquility gives place to abrupt changes of mood and theme. It's a characteristic that becomes more plainly evident on side 2, which ultimately explodes into a maelstrom of rock sound, switches back to organ, then to a frantic jig and, just when it would seem to be all over, into a weird background sound. I guess it's this smorgasbord of mood and theme that has captivated listeners around the world, added to the thought that it's largely the concept and creation of one man, with just a little help beyond the 17-odd instruments he plays himself, plus the odd vocal sound effect.

The quality is okay and, if you have a 4-channel outfit, you may as well get this quadraphonic version, the more effectively to get yourself submerged in the Oldfield sound. (W.N.W.)

I ONLY HAVE EYES FOR YOU. Tony Mottola, guitar. Matrix quadraphonic, Project 3 (Festival) LQ-35839.

While Roy Atkinson of Festival had most to say about their quadraphonic version of "Tubular Bells", it was this one by Tony Mottola that caught my admittedly square ears, perhaps by way of relaxation!

Produced by Enoch Light and with backing by such well known associate instrumentalists as Dick Hyman, Vinnie Bell, Phil Kraus, Jule Ruggiero and Ronnie Traxler, it is very musical, undemanding and very easy on the ear. The track titles include: I Only Have Eyes For You – One – Send In The Clowns – Don't Stand A Ghost Of A Chance With You – What Did I Do For Love – Jelly Belly – Our Day Will Come – Time In A Bottle – The Most Beautiful Girl – Solace – A Stranger In The Town – Love Won't Let Me Wait.

While the sound is pleasant, what will really catch the ear of any hifi fan is the complete freedom from stress or distortion and the way it all emerges out of absolute silence. The even dynamics would have helped but Enoch Light has a name for this kind of quality. And the quadraphonics? What if it does exaggerate the dimensions of the guitar here and there, it keeps Tony Mottola out front while the other musicians sit around the room doing their gentle thing. Recommended. (W.N.W.)

LIGHTER SIDE—continued

THE WORLD OF CHILDREN'S CLASSICS. Various artists, conductors, orchestras. Stereo, Decca SPA-366.

The titles and the little blond miss on the cover seek to classify the album but I really wonder how many such kiddies in the home enviroment would choose to listen to it, despite the "animal" titles; in school, maybe, but seldom at home. Even "Peter and the Wolf" is presented minus the narration. The full track list:

Carnival Of The Animals (Saint-Saens) – The Little White Donkey (Ibert) – Puss-In-Boots And The Little White Cat (Tchaikovsky) – Flight Of The Bumble Bee (Rimsky-Korsakov) – Sheep May Safely Graze (Bach) – Trout Quintet Theme & Variations (Schubert) – Peter And The Wolf (Prokofiev).

They're all very well known, of course, and all very well played, but I would suspect that they'd be enjoyed more by the adult kids in the home then the real ones! Compiled from Decca's extensive classical repetoire, the recordings date from as far back as 1958, but don't let that deter you. The quality, even now, is a reminder of just how far afead Decca was in those days. And George Malcom's version of Bumble Bee on harpsichord (1962) is a "bottler".

Call it what you like, it's a typical, easy listening collection of evergreen classical snippets. (W.N.W.)

★ ★ ★

HIGHLIGHTS FROM THE MERRY WIDOW BALLET. Franz Lehar. The Adelaide Symphony Orchestra and Adelaide Singers conducted by John Lanchbery. HMV stereo SAN 7588.

This record is destined to become a collector's item. The world premiere of this balletic version of The Merry Widow was given by the Australian Ballet in Melbourne on the 13th November, 1975. This recording was produced in conjunction with the ABC in the ABC studios, Adelaide.

And while I cannot comment on the standard of the ballet in this Australian production I can state that the musical arrangements are very bright and fresh. In fact, I liked this version more than the original operetta. Recording quality is superb and a credit to the ABC and EMI. (L.D.S.)

★ ★ ★

THE VERY BEST OF BRASS. Studio 2 Stereo TWOX 1048. EMI Release.

I don't recommend this record if you have a headache or are feeling a bit fragile after the night before, as the band comes on strong on every track, with sixteen brass standards like: The Stars And Stripes Forever – The Dam Busters – Grand March From 'Aida' – Radetzky March – The Liberty Bell – Blaze Away – Men of Harlech. The tracks are taken from masters ranging from 1963 to 1975 and the band or bands remain anon.

The stereo image is quite noticeable on some tracks and overall quality is quite good, making it an excellent record to give to that brass band enthusiast you know. Or else buy it to get your own back on the neighbours! (N.J.M.)

★ ★ ★

RICOCHET. Tangerine Dream. Virgin Records L 35736. Festival release.

This is another offering from Tangerine Dream, the German electronic music specialists. This one was recorded live in England and France late in 1975. As is usual with their records, there are no definite tracks, the whole album is intended as a continuous piece of music, which flows smoothly from one segment to the next.

As one would expect, a large number of synthesisers of various sorts have been used to produce the usual synthesiser type sounds. But don't get me wrong, this record is not just a collection of sounds, it is a blended whole, and should be listened to as such.

This style of music obviously appeals to a limited audience. I have not as yet decided whether or not I belong in this class, so I have not been able to come to a definite conclusion about this record. Technically, however, the production is excellent, with good tonal balance, and little background noise. (D.W.E.)

NO EARTHLY CONNECTION. Rick Wakeman and the English Rock Ensemble. A & M Records L 35885. Festival Release.

This is another concept album from Rick Wakeman, following on from his earlier efforts, "Journey To The Centre Of The Earth" and "The Myths And Legends Of King Arthur And The Knights Of The Round Table". Musically, this piece seems to differ only slightly from his earlier works, and it gives the overall impression of staleness.

"I've always believed that if you provide something for the eyes as well as the ears, there's more chance of getting people to pay attention to the music", Rick is quoted as saying. To me, however, it seems that this album is rather like the sound-track of a B-grade movie, purposeless if you haven't seen the movie.

In the case of this album, the accompanying lyrics and pictures do help to fill in a few of the gaps, but do not seem to give the music the lift it requires. Summing up, this album will undoubtedly appeal to devoted fans, but will be unlikely to win any new ones. As usual with Festival releases, record quality is excellent. (D.W.E.)

★ ★ ★

NAT KING COLE. The King Cole Trio. Trip TLP-5811. Distributed by Astor Records.

Before Nat King Cole became really popular in the fifties as a singer he saw some hard times. He played piano and did the occasional vocal in the King Cole Trio which was formed in 1939. Do not expect high quality sound from this album as it is remastered from 78's made back in the 40's. It makes pleasant listening if you make allowance for the quality and provides an interesting insight into Nat King Cole. Buyers will also appreciate the well written album notes.

Track titles are as follows: Slow Foot Joe – 1-2-3-4 – Crazy 'bout Rhythm – Off The Beam – King Cole Blues – Jiving With The Notes – Early Morning Blues – Bed Time – Honey Hush – French Toast – Vine Street Jump – B Flat Blues – You Send Me – Love Is My Alibi – Pogo Stick Bounce. (L.D.S.)

Reader's Digest: Popular organ

21 POPULAR ORGAN FAVOURITES. Various organists and instruments. Stereo, Reader's Digest, record RD4-130. Also on cassette RDCP4-131. Price in both cases $2.99 post-free from Reader's Digest, Box 65, GPO, Sydney 2001.

While this collection will most obviously appeal to enthusiasts of the popular organ, it could also find a place as a typical organ disc in the average collection. Old-timer Reginald Dixon opens in fine style with his famous Blackpool Ballroom pipe Wurlitzer, and provides four other tracks as well. The remaining tracks use electronics: Richard Wayne and Ken Griffen play Hammonds, Richard Wayne (again) and Harry Stoneham play Lowreys, while Bob Benson features on a Baldwin.

Track titles include Happy Days & Sally – Summer Samba – Don't Get Around Much Anymore – Take The "A" Train – Hawaiian War Chant – If You Knew Susie – You Can't Be True, Dear – Tennessee Waltz – Patricia – Tip Toe Through The Tulips – Love Letters In The Sand – Tico, Tico – Cruising Down The River – In The Good Old Summer Time – Bali Ha'i – In A Little Spanish Town – Anniversary Song – Four Leaf Clover & Bye Bye Blackbird.

As you can see, you get quite a lengthy program, for your money, of good average popular organ music, and the opportunity to compare styles and instruments – with the odds favouring Reginald Dixon and his big traditional Wurlitzer.

Having both disc and cassette available, I was able to play them simultaneously and make instant A-B comparison. They're both okay but, if you have a good magnetic cartridge, take the disc, which also provides jacket notes. (W.N.W.)

New Products

Yaesu Musen Communications receiver

For those on the lookout for a modern, general purpose communications receiver, the Yaesu Musen FRG-7 is well worth closer investigation. It is compact, self-contained and employs the now well known Wadley Loop principle to provide stable and predictable coverage of the frequency range from 0.5MHz to virtually 30MHz.

The Wadley Loop principle was described in detail some years ago by Ian Pogson, as a preamble to his description of the Electronics Australia "Deltahet" receiver. (Ref. Electronics Australia, June 1963, January 1971.) The principle is also explained in the instruction book which accompanies the receiver, the most obvious differences being in the choice of intermediate frequencies.

Conforming to the Wadley Loop configuration, the FRG-7 is essentially a triple-change superhet. Incoming signals between 0.5 and 30 MHz pass through an RF amplifier stage and then are fed to an up-converter which shifts them into the first IF channel having a pass-band 1MHz wide centred on 55Mhz.

These signals are heterodyned, in turn, by a frequency of 52.5MHz approx., synthesised from a mix of the first variable tuned oscillator (serving the up-converter) and the harmonics of a 1MHz crystal locked oscillator. This time, the signals are down-converted into a second IF channel, again 1MHz wide but centred on 2.5 MHz.

By making both conversions dependant on the one tuneable oscillator, it is possible to arrange matters so that any drift in the front-end circuitry tends to cancel, ensuring that the second IF resultant will be rock steady.

A tuneable oscillator in the range 2455 to 3455kHz, which can be expected to be intrinsically stable, is used to down-convert to 455kHz and to a conventional circuit configuration thereafter.

In terms of the panel controls, the most obvious result of this unusual circuit configuration is that the tuning dial for the second variable oscillator 2455 to 3455 can become the main "bandspread" dial always covering exactly 1MHz and with an appropriate 1MHz bandspread scale calibrated to every 10kHz. In effect, this dial serves to display any 1MHz segment of the total frequency range (0.5 to 30MHz) as selected by the front end.

As might be expected, a different tuning procedure is used: To select a certain frequency—say 14.12 MHz—the band switch is set to position D covering 11-29.9MHz.

The Megahertz knob is rotated next to bring the 14MHz figure under the hairline in the MHz window. When it is properly set, an adjacent red "Lock" indicator light goes out.

The Preselect knob is now adjusted to bring up the desired frequency indication in its window, after which the main tuning dial can be set to 120kHz to produce the final figure of 14.120MHz.

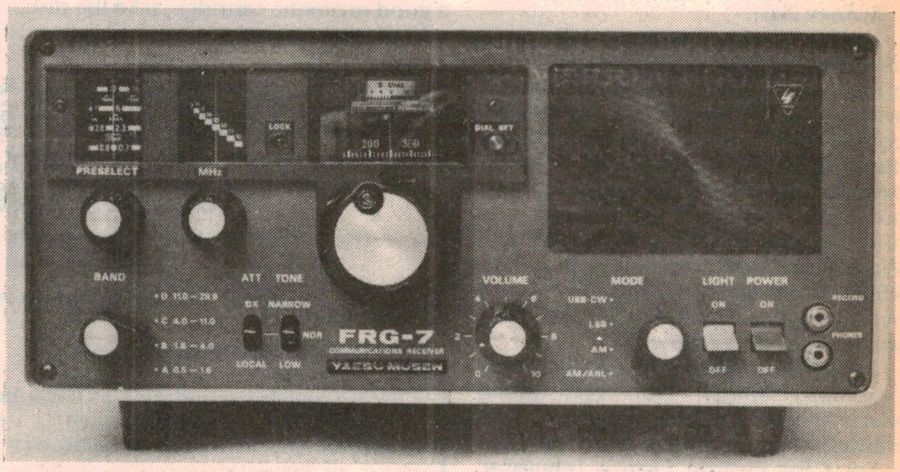
It sounds complicated but it only takes a few minutes to become accustomed to the procedure, after which a frequency can be dialled or read-off without hesitation, and in the knowledge that it will be substantially accurate and will stay put!

Other controls include a volume control and a mode switch, the latter providding for upper sideband and CW reception, lower sideband, ordinary AM, and AM with automatic noise limiter in circuit.

Four panel switches provide optional attenuation for very strong signals, three settings for audio bandwidth, an on-off switch for the panel lighting and a general on-off switch which is effective for both external power and for internal batteries where these are being used as an alternative supply.

A phone jack is provided for private listening and insertion of the phones cuts out the loudspeaker automatically. The "Record" jack above it provides about 50mV of signal for an external tape recorder irrespective of the setting of the volume control.

Internally, the circuitry involves 2 integrated circuits, 9 FETs, 13 transistors, 14 diodes and 2 zener diodes. Normal operation is from the AC power mains, but alternatives include an external negative earth 12V supply or 8 internally fitted UM1 type dry cells. Voltage regulation is effective in all modes. Overall size is 340mm (W), 153mm (H) and 285mm (D), and weight without batteries is 7kg.



The Yaesu Musen FRG-7 is compact and self-contained. The preselect dial (top left) is used in conjunction with the bandswitch below it. Alongside it is the MHz selector which is used in conjuction with the "lock" indicator light. In the centre is the main bandspread dial with the S-meter just above it. The remaining switches and knobs are as mentioned in the text.

For broadcast band listening (0.5 to 1.6 MHz) an ordinary high impedance (long wire) aerial is assumed. For frequencies above 1.6 MHz, the makers have provided for an input of 50 ohms unbalanced, on the assumption that, for some applications at least, a resonant dipole will be used. Provision is also made for an earth connection and for muting when the receiver is paired with a transmitter.

Manufacturer's specifications put the sensitivity as better than 0.7uV for SSB/CW for a S/N of 10dB; better than 2uV at S/N 10dB for AM. Selectivity is given as ± 3kHz at –6dB and ± 7kHz at –50dB. Stability: Less than ± 500Hz at any 30 minutes after warm-up. Audio output: 2 watts into 4 ohms.

As supplied, the FRG-7 comes complete with a 16-page instruction manual and a large fold-out circuit diagram. The manual contains a general description,

specifications, user instructions, a description of the circuit principles, alignment and maintenance details, voltage chart and parts list. An additional loose sheet indicated means of setting the dial calibration to any available standard frequency signal.

As distinct from bench measurements, which we were prepared to take for granted, in this case, two members of our staff adopted the user approach and simply took the receiver home to see how it performed under typical conditions.

While we had the advantage of being familiar already with the Wadley Loop system, our impression is that it would take very little time for even the uninitiated to become thoroughly at home with the tuning procedure. In fact, provided the user can think in terms of frequency—and what amateur and DX listener can't—the system is likely to be less confusing than the more usual bandset/bandspread/calibrate system where all the calibrations are interdependent.

As it was, we found that the receiver could be set to any frequency using 10kHz calibration marks, or interpolating for intermediate figures. Calibrations generally were within the tolerance one normally puts down to parallax and there was certainly no urge to attempt to adjust them more precisely.

All controls worked smoothly, with tuning on SSB signals needing care but not posing any problem for the initiated operator.

The selectivity was somewhat down on that of our own "Deltahet" design and it was therefore not able to separate out congested signals quite as well. With only one ceramic filter at 455kHz, the designers have apparently settled for a passband which will give reasonable selectivity in a communications role, without being too sharp on normal double sideband AM.

On the other hand, they have exercised a lot of care with that bugbear of multi-change superhets—spurious responses. While we did not search the whole spectrum diligently for them, they were certainly not evident in ordinary usage.

That phrase "the whole spectrum" is itself significant. The FRG-7 does give complete, fully calibrated, bandspread coverage of the whole spectrum. The purchaser does not face an agonising choice as to what parts of the spectrum he really wants to cover, or over what parts the bandspread is to be most effective. The FRG-7 would therefore seem to be an excellent choice for the listener who wants to listen to almost anything going, anywhere in the HF spectrum.

Further details of the Yaesu Musen FRG-7 can be obtained from Bail Electronic Services, 60 Shannon St, Box Hill Nth, 3129 Vic. (WNW & ILP)

DIGITAL CLOCK KIT FROM TANDY

Currently available from Tandy Electronics is a complete kit for an electronic digital clock, priced at $19.95. An attractive project, it can be assembled by a home handyman, who does not need to have any special electronic skills to complete the job.

Branded "ArcherKit", an associate company of Tandy and Radio Shack in America, the project comes as a boxed set complete with general construction hints and a fully illustrated step-by-step construction guide. Typically, construction would involve about three evenings' work, although it could be completed in shorter time if one really tried.

The clock takes its timing pulses from the mains. Links on the board accommodate to either 50Hz or 60Hz, the former being appropriate for Australia. The constructor also has the option of 12-hour or 24-hour display, time being shown in hours, minutes and seconds.

The kit contains two printed circuit boards, the larger one carrying the 24-pin LSI clock chip (MM5314) already mounted. All other components are "discrete": 9 diodes, 20 transistors, 37 resistors and 4 capacitors, plus sundry hardware. Mounting all these takes time and patience, but it is also a practical lesson in assembly for those who are keen to gain experience along these lines.

Needless to say, the instruction book should be carefully studied before construction begins.

The actual time is displayed on six 7-segment fluorescent readout tubes, as distinct from LEDs. They provide a blue-green display which can be seen clearly, even in a brightly lit room. A switch at the rear allows the display to be dimmed or switched off, which is just as well, because it is bright enough to double as a night light in a darkened room!

Other controls on the back of the clock offer two speeds of fast forward cycling for rough time setting, and a hold switch allowing the clock to be restarted in synchronism with a time signal.

The ArcherKit electronic digital clock kit (Cat. no. 28-4040) is currently available from Tandy stores throughout Australia. In the event of difficulty, Tandy can provide a back-up service, while spare parts should be available for at least 5 years. (W.N.)

NEW PRODUCTS

Dynatel 500 telephone cable locator

The Dynatel 500 is a new concept in telephone cable location and identification. When combined with Dynatel's 710A Portable Cable Resistance Fault Finder, fault location time is greatly reduced, even in congested joint service areas.

The Dynatel 500 features a silent test tone transmitter which avoids interference to adjacent working lines and minimises the "pulling effect" of adjacent pipes and cables. The same concept makes the 500 immune to power line interference, prevents audible noise on the line under test, and permits tests even while the line is in use.

The transmitter output can be coupled to the line under test by means of a unique "Dynacoupler". This device makes it extremely simple to place tracing tone on any cable without removing the shield bonding or ground.

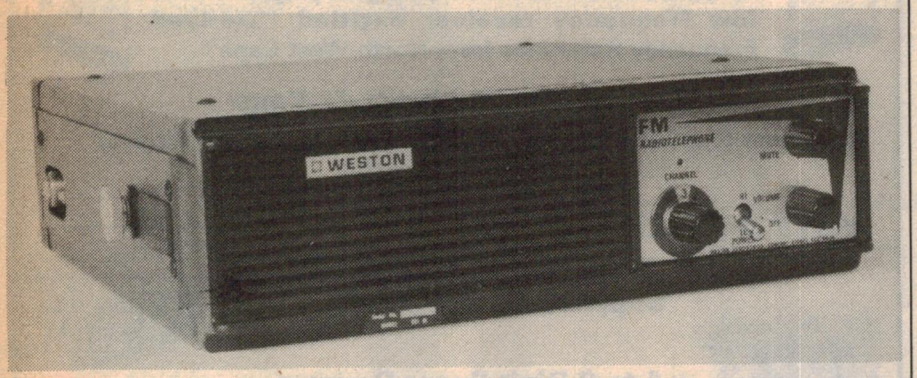
The Dynatel 500 is designed to make operation and hookup simple, safe procedures. The lightweight receiver unit is made for one-handed operation and features fingertip adjustment controls plus an easy to read meter. There are no clumsy wands, cords or ground rods. An integral monitor speaker with volume control and earphone jack is provided.

Both null and peak readings can be made at the flick of a switch, depending on the nature of the locating job. In addition, the 500 offers a highly accurate vertical depth measurement technique that is superior to the 45° triangulation method.

For further information contact Aegis Pty Ltd, PO Box 49, Thornbury, Vic 3071. Telephone 49 1017.

Weston 551M marine radio telephone

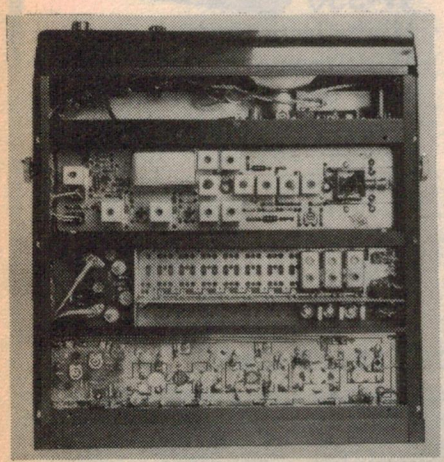
The recent introduction of a VHF marine radio service (see EA, September 1976) has created a demand for commercial equipment to suit this service. Recently submitted to us for review was the Weston model 551M marine radio telephone.



The model 551M is an all-Australian product designed to meet the exacting specifications laid down by the authorities for mobile radio telephones in general, and those for the marine service in particular. In fact, the 551M is a modification of the well established and proven model 551 land mobile unit. This unit earned the coveted Good Design label of the Industrial Design Council of Australia.

The 551M is an all solid state unit with an impressive list of specifications. It is designed for use in the 156 to 174MHz band and can be fitted with up to 10 channels, within a bandwidth of 500kHz. It operates from a conventional 12V electrical system as normally available in most vessels, being actually designed around a voltage of 13.8, ±10%. On standby, with no signal, the receiver draws 0.1A.

Other receiver specifications are: Usable sensitivity, better than 0.4uV for 12dB SINAD. Quieting sensitivity, better than 0.5uV for 20dB. Squelch sensitivity, better than 0.35uV. Adjacent channel selectivity, –85dB.



The Model 551M is all solid state and features rugged, modular construction.

The audio power output is 3W with a distortion of less than 5%. The frequency response follows a 6dB per octave de-emphasis characteristic (+1,–3dB), which is complementary to the transmitter characteristic, within the range 300 to 3000Hz.

The transmitter has two power output levels: 25W and 1W. Current drain on transmit is 4A for the 25W position and 1.5A on the 1W position. Deviation is ± 5kHz (max.) and spurious emission is less than 2.5uW.

The complete unit measures 76mm (H) × 268mm (W) × 297mm (D) and weighs 4.1kg. It may be mounted in any position and comes complete with substantial mounting cradle and brackets, microphone, whip antenna with coax cable and connector, and battery cable with connector.

The unit is very solidly made and employs a modular form of construction, which simplifies modifications to suit individual customers' requirements and also simplifies service.

Optional extras include a remote handset, or a remote control unit, for use where it is desired to mount the main unit in an out-of-the-way location. Selective calling can also be fitted, eliminating the nuisance of irrelevant traffic on shared frequencies.

A sample unit was set up in our own laboratory and, even when connected to an aerial inside the building, on a shelf immediately above it, provided clear signals from both land based and mobile marine transmitters.

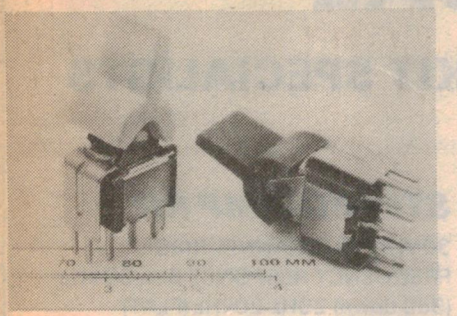
Overall, our impression is one of a well designed, ruggedly constructed unit which should stand up to years of hard work in a marine environment.

Price, including two mandatory channels, and sales tax, is approximately $680.00. Additional channels cost $35.00 each.

Further details from Weston Electronics Company, 215 North Rocks Rd, North Rocks, NSW, 2151. (P.G.W.)

NEW PRODUCTS

Switch support bracket



The C & K range of subminiature switches are now available with vertical support brackets for PC mounting applications. The brackets are designed to absorb actuation stress, thereby reducing stress at the switch terminals, and can be supplied to user specifications as required.

Further information from C & K Electronics, Office 2, 6 McFarlane St, Merrylands, NSW 2160. Telephone 682 3144.

Compact, low-cost digital multimeters

Two compact, low cost digital multimeters have recently been released by the John Fluke Manufacturing Company, Seattle, USA, and are available in Australia from Elmeasco Instruments Pty Ltd. They are the 3½-digit 8030A and the 4½-digit 8040A.

Both instruments feature excellent overload protection and measure DC voltages, AC voltage (true RMS), DC current, AC current (true RMS) and resistance. The 8030A also features a diode test facility, while the 8040A provides for both auto and manual ranging.

Power supply requirements may be met either by disposable alkaline batteries, rechargable NiCd batteries, or from a mains supply. A full range of accessories is available, including carrying case, high voltage probe, 2 RF probes, and a 600A current probe.

Elemeasco Instruments also wish to advise that they have been appointed Australian sales representatives for the range of function generators manufactured by Exact Electronics, Oregon, USA. A catalogue is available.

Also available from Elmeasco is a 17-page brochure put out by Teledyne Philbrick entitled "How to Choose an Operational Amplifier". The brochure dicusses monolithic, hybrid and discrete module construction and offers practical advice on the selection of op-amps.

Further information from Elmeasco Pty Ltd, PO Box 30, Concord, NSW 2137.

Changes at Optro

During the past few months, Optro Pty Ltd has undergone a restructuring process with the aim to provide more efficient customer service. Although, production will now be somewhat limited, the company intends to continue with its standard local products on a subcontract basis. These include equalisers, limiters, logo generators, and audio processors.

Optro has also secured many excellent agencies in the audio and video fields, including Advent large screen television, Allen and Heath consoles, Cadac professional consoles, Ampex audio tape, JPL speaker systems, IGM Automation, Taber audio equipment, and STL test tapes.

Further information from Optro Pty Ltd, 17 Arawata St, Carnegie, Vic 3163.

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FEATURES
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30 WATTS / CHANNEL RMS
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ALLOW
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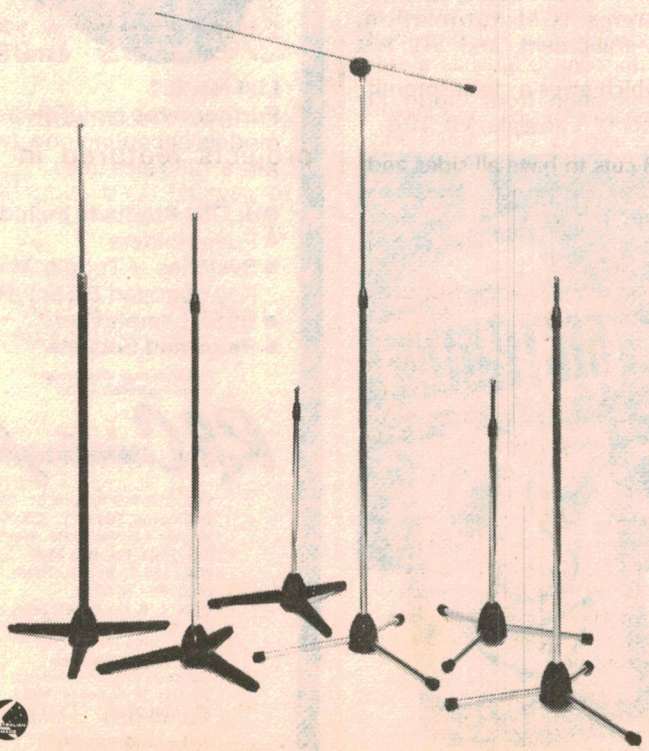

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Letters to the editor

Logic expressions

With reference to your Logic Design articles in the May and June editions, may I point out some rather significant errors before the would-be logic-designers amongst your readers commit suicide. I must apologise to these readers for not commenting last month, but assumed that you would be inundated with letters on the subject.

In the May issue, Page 94:

$Z = \ldots + \bar{A}.B.\overline{C.D}. + \overline{A.B.C}.D.$

should read

$Z = \ldots + \bar{A}.B.\bar{C}.\bar{D}. + \bar{A}.\bar{B}.\bar{C}.D.$

and in the June issue, Page 89, Fig. 5 (b):

$\overline{A.B.C}.$ should read $\bar{A}.\bar{B}.\bar{C}.$

$A.\overline{B.C}.$ should read $A.\bar{B}.\bar{C}.$

$\overline{A.B}.C.$ should read $\bar{A}.\bar{B}.C.$

and Page 91:

$Z = A.\overline{B.C}. + \bar{A}.B.\bar{C}. + \overline{A.B}.C.$

should read

$Z = A.\bar{B}.\bar{C}. + \bar{A}.B.\bar{C}. + \bar{A}.\bar{B}.C.$

E. F. Atkins
Carine, WA

COMMENT: These are not strictly errors if one adopts the convention that all conjunctive terms must be enclosed within brackets. The continuation of the negation bar where two or more adjacent terms are both negated tends to have advantages for typesetting, and this is why we used it in the cases you cite. However, we agree that it can cause confusion, and thank you for drawing the attention of readers to this.

TV interference

Upon reading your article in June EA regarding RFI, I thought some of your readers may be interested in a couple of solutions I have found for TVI in particular.

Several of my neighbours complained to me of interference resulting from operation of my amateur station on 7 and 14MHz.

The fault appeared to be severe cross modulation of the composite video signal, resulting in tearing of the picture and interruption of the sound.

After many hours of work, I found that the simplest cure for common mode conducted TVI is the insertion of a longitudinal choke in the coax to the receiver, installed close to the input socket. A longitudinal choke consists of several turns of the coax feedline threaded through a large toroidal ferrite core (the sort used for audio crossover coils).

In another case, where the viewer was using an antenna with 300 ohm feedline, I simply made up a balun to convert it to 75 ohm and installed a longitudinal choke between the balun and 75 ohm input connector of the receiver. For particularly stubborn cases, it may be necessary to use a coax fed antenna, high pass filter and longitudinal choke.

If TV set manufacturers installed these components as a matter of course, everyone would be happier.

D. Diamond, VK3XU
Ashwood, Vic.

Speaker boxes

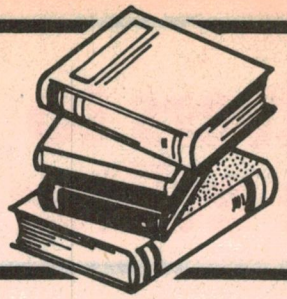
As one in the process of construction the 3-45L Speaker System, I was interested in the 3-41L design in the June 1976 issue. I would point out however to anyone else manufacturing their own speaker boxes that the 45 litre box is the simplest to construct.

Readily available from most timber distributors is the 300 x 18mm particle board in 4 metre lengths. The board is designed for shelves and has an added advantage in that one edge has a soft wood insert which gives a clean smooth front to the speaker boxes. One length of this cost me approx $7.00 and I only had to make 8 cuts to have all sides and tops for the boxes with only about six inches of waste.

R. G. Watts
Wallsend, N.S.W.

COMMENT: Thank you for the information. Constructors working with this material may as well take advantage of the extra internal volume. No other changes will be necessary. Our observations were made after talking with manufacturers who normally work from metric size sheets.

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.



Books & Literature

For radio amateurs

VHF-UHF MANUAL. By D.S. Evans G3RPE and G.R. Jessop G6JP. Third edition, published by the Radio Society of Great Britain. Hard covers, 416pp 245 x 190mm, fully illustrated with photographs and circuits.

RSGB publications have a reputation for being informative and well produced, and this latest edition of their VHF-UHF Handbook is certainly no exception. Looking through it, one could easily get the impression that, if its not in the handbook, you don't need to know it anyway!

Devoted to that part of the spectrum above 30MHz, the text is a mix of basic theory, essential reference data and practical "how-to-build it" information.

Chapter headings are: Introduction — Propagation — Tuned Circuits — Receivers — Transmitters — Filters — Aerials — Microwaves — Space Communication — Test Equipment and Accessories —Data.

According to the publisher's notes, the book has been revised and up-dated throughout but not to the point where they have expunged valve circuits, where there is a point in retaining them. What is completely new is a chapter on microwave techniques for bands up to a24GHz, and another on space communication techniques, mainly to do with the OSCAR satellites.

All told, it appeals as a book which would be invaluable to any amateur or aspiring amateur interested in frequencies above 30MHz.

Review copies were received both from the UK publisher and from Dick Smith Electronics, of P.O. Box 747, Crows Nest NSW 2065, who advised that their catalog number is B2054, and that the book is priced at $12.50 (W.N.W.)

Radio & hi-fi

TUNERS AND AMPLIFIERS by John Earl. Published 1970 by Fountain Press, London. Hard covers, 187 pages 220 x 145mm, illustrated by photographs and circuits. Price in Australia $7.50.

I reviewed this then-new book by John Earl in January 1971, making the remark that its value would be somewhat downgraded for Australian readers because of our lack, then, of a stereo/FM service. The initiation of such a service is possibly one of the reasons why the distributors are once again drawing attention to the book, indicating that it is available from stock.

Chapter headings are: Modern Equipment — State Of The Art — Choice Of Equipment — Use Of The Amplifier — Use Of The Tuner — The Tuner-Amplifier — Systems and Compacts — Specifications.

Written in 1970, the text reflects the technology of the time, based on solid state, but with integrated circuits and related techniques still largely in the labs. Furthermore, the equipment discussed is predominantly of British manufacture, with little hint of the huge array of Japanese designs long familiar on the Australian market.

If you want a direct guide to the choice of currently available hifi gear, this book therefore won't help you much. On the other hand, if you want to reinforce your understanding of basics, you will find the

text well written and highly readable. Our copy came from Thomas C. Lothian Pty Ltd, 4-12 Tattersall's Lane, Melbourne, 3000. (W.N.W.)

Design charts

ELECTRONIC DESIGN CHARTS, by Norman H. Crowhurst. Tab Books, Pennsylvania. Soft covers, spiral binding, 220 x 285mm, 128pp. Price $9.75, plus postage where applicable.

This is the fourth printing of well-known US writer Norman Crowhurst's collection of electronic design charts, tables and graphs. Dick Smith Electronics tell me they have been specially importing it, because of the demand from customers. I can well understand this, because the book certainly provides a wealth of useful reference information—and for a quite modest cost by modern book standards.

There are simple charts, like that to convert from frequency to wavelength, right through to a set of multi-step design charts for iron-core inductors. Each one is accompanied by text which explains exactly what the chart is capable of telling you, and how to drive it.

In short, the book gives every evidence of the care and thoroughness we have usually come to associate with the name of Norman Crowhurst. This together with the value of the data itself should ensure it a place on the reference shelf of almost all serious electronics designers, whether professional or amateur.

The review copy came from Dick Smith Electronics Pty Ltd, of 162 Pacific Highway, Gore Hill, NSW 2065, from whom it is available both directly and via mail order. (J.R.)

Higher maths

CONVOLUTION AND FOURIER TRANSFORMS FOR COMMUNICATIONS ENGINEERS by R. D. A. Maurice, first edition, published 1976 by Pentech Press, London. Hard covers, 198 pages, 51 illustrations, size 220 x 144 mm. Price in London: £7.50.

Intended for broadcasting and telecommunications engineers and technician engineers, as well as for students pursuing undergraduate or postgraduate courses in communications engineering, this book explains the process of convolution from basic concepts. Many examples, chosen from real life situations, are used to compare the convolution process with the more widely known Fourier or Laplace transform processes.

There is a certain amount of bias in the examples given towards the broadcasting and television sides of communications engineering, but this does not detract in any way from the main subject matter.

The review copy was obtained direct from the publishers, and no details were supplied as to Australian price or availability. (D.W.E.)

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BARLOW WADLEY STANDARD **$269 + P&P**

WITH FM **$298 + P&P**

The new Yaesu FRG-7 General Coverage Receiver features ac/dc operation and the famous Wadley Loop principle with spin tuning and phase-locked synthesiser providing complete coverage from 500 KHz and 30 MHz to an accuracy better than 5 KHz. Please write for further technical details (enclosing SAE).

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OUR PRICE *$255 plus P&P

$ 255

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Listener 3 Long range wire dipole antenna 3-30 MHz complete with Balun, feed wax, VHF plugs, insulators. Ideal for the serious SWL ***$42.00** plus P&P.

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Popular VC 2 SWR/Pwr METER operates 3-150 MHz with power measurement 12/120 watts. Will handle up to 100 watts. 50 ohm impedance, twin meters. A bargain! **$29.80**

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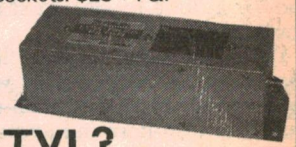
Suberb quality low pass filter (32 MHz cut-off) will handle up to 1 kW pep. 50 ohms impedance with insertion loss better than 0.3 dB. Copper construction with SO239 sockets. **$28** + P&P



TVI ?

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CL-666, 2.5kW, 80-10m, heavy duty, superb construction $235
CL-66, 500W 80-11m, built-in 4 position co-ax switch ..... $ 98
CL-99 200 watts for 2m band ..... $ 47

TEST GEAR

YO-100 monitorscope $215
YC-355D frequency counter $290

2 METRE ANTENNAS

ARX2 Ringo vertical ..... $ 40
DINGO X2 Identical to above but locally manufactured ..... $ 35
LA210W twin boom 10el stacked beam . $125
AS210BN twin boom 18dB gain ..... $ 99
AS210AN single boom 14.5dB gain ... $ 38
Y7 crossed yagi, 7el with 7dB gain .... $ 65

HUSTLER WHIPS

RM-80 (80 metres) ..... $ 26
RM-40 (40 metres) ..... $ 25
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MO-2 mast ..... $ 26
BM-2 bumper mount ..... $ 15

HF TRAP DIPOLES

Midy HIN trap dipole 40-10m . $ 38
Midy VN trap dipole 80-10m .. $ 44
AL48DXN trap dipole 40-80m . $ 38
AL24DXN trap dipole 20-40m . $ 28

ANTENNA ACCESSORIES

Ham II Heavy Duty Rotator ... $175
CD44 medium Duty rotator ... $140
U-200 light Duty rotator ..... $ 62
Rak dipole balun ..... $ 22

ATLAS 210X/215X Solid-state HF TRANSCEIVER **$625.**

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The New IC215 3w 2 metre handy portable transceiver complete with 3 channels.

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The popular IC502 3w 6 metre handy portable, vfo controlled 52-53 MHz. SSB and CW modes

SSB $ 175

The IC202 3w ssb/cw 2 metre handy portable, VXO control, noise blanker.

SSB $ 185

All portables have provision for external 13.8 Vdc and antenna. Set includes dry cells, mic, carry-strap, plugs. All sets given pre-sales checkout and as VICOM are the Distributors for Australia, a comprehensive range of spare parts are available.

NEW !

INNO-HIT

CB-1000

$ 245

27 MHz SSB SYNTHESISED

This superb new rig is the ultimate in quality and sophistication! The rig is synthesised and requires no crystals - accuracy is within 0.001%! There are 69 available modes, 23 AM, 23 LSB, 23 USB at 5 watts AM and 15 watts pep Runs from 13.8 vdc either positive or negative earth. Controls include squelch, rf gain, clarifier, noise blanker (RF type) and transceiver PA system switch. Front panel meter indicates "s" points or RF output. The rig comes complete with mic, mobile mounting brackets, dc cable and VICOM 90 day warranty.

IDEAL FOR THE NOVICE

PLUGS AND SOCKETS

minimum mail order $5	
PL259 plugs with reducer	$1.20
SO239 chassis socket	$1.20
SO239/PL259 rt angle connector	$1.95
SO239 3 female "T" adapter	$2.00
"T" connector	$2.20
Solderless in-line RG58 splice	.90
18" coax jumper lead with PL529's	$2.00
3' coax jumper lead with PL259's	$2.20
3 pin mic plugs & sockets	$1.50
4 pin mic plugs & sockets	$1.20
RG58A/U 52 ohm coax - 45c per metre	
RG8 low loss coax - 45c per foot	

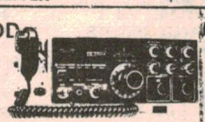
27MHZ WHIPS

Base loaded stainless-steel whip, 40.5 inches, 50 ohm impedance, vswr less than 1.5. Includes roof-top mount, optional boot lid mount, spring and coax with PL259 plug. Tensile strength 260,000 lbs/one sq inch!

$ 22

KENWOOD TS-700A

$ 575



The promise of 2 meter operation...the Kenwood way. The TS-700A operates all modes: SSB (upper & lower) /FM/AM/CW and provides the dependability of solid state circuitry. Has tunable VFO and 4 MHz band coverage (144 to 148 MHz). Automatically switches transmit frequency 600 KHz for repeater operation. AC and DC capability through its built-in power supply. Outstanding frequency stability Complete with micro phone and built-in speaker.

uniden "... the best value."

The fabulous Uniden 2020 phase-locked-loop transceiver offers separate usb/lsb/cw 8-pole crystal filters as standard and 6146B's in the final with screen voltage stabilisation for minimum distortion products. Features plug-in pcb's and even the front panel can be swung out for easy servicing. A full spares catalogue is available together with change-over pcb's. Compare the Uniden 2020 with other HF transceivers and you'll be quickly convinced that it offers the best value! The price $570 includes mic, cables, plugs, English manual and VICOM 90-day warranty! But don't get caught ... VICOM is the only factory authorised dealer for Australasia.

DISTRIBUTORS:

Adelaide:	Graham Stallard, 27 White Ave, Lockleys. Phone 43 7981
Brisbane:	Elite Electronics, 69 Wardell St, Dorrington. Phone 38 4480
Canberra:	Daicom, 32 Kalgoorlie Crs, Fisher. Phone 88 4899
Perth:	Netronics, 388 Huntriss Ave, Woodlands. Phone 46 3232

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139 Auburn Rd, Auburn, Vic. 3123 Ph: (03) 82-5398
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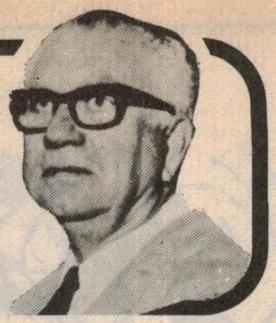
23 Whiting St, Artarmon, NSW 2064 Ph: (02) 439-1271

Prices and specifications subject to change without notice. Prices include Sales Tax but exclude freight and Insurance. Allow 50c per $100, minimum $1.

The Amateur Bands

by Pierce Healy, VK2APQ



19th Jamboree-on-the-Air

For the past eighteen years this unique event has, through the collaboration of amateur radio and world scouting organisations, enabled Boy Scouts and Girl Guides to exchange greetings and personal expressions of good fellowship.

The 19th Jamboree-on-the-Air to be held over the weekend 16th and 17th October, 1976 will again provide that opportunity for young people to participate in this worldwide event.

In addition, the annual J-O-T-A can demonstrate to communities large and small, irrespective of nationally, size, or wealth that amateur radio can stimulate a sincere and friendly link between nations, on a scale that cannot be surpassed by any of the usual communication channels.

His Excellency the Governor-General and Chief Scout of Australia, Sir John Kerr, will perform the official opening ceremony for Australian participation in the 19th J-O-T-A.

The ceremony will take place from the official Headquarters station, VK1BP. The broadcast will be made as near as possible to the following frequencies, 7070kHz and 14170kHz at 10.00am on Saturday 16th October, 1976. It is hoped that propagation conditions will permit all branches in Australia to hear this important ceremony. It is planned to monitor both frequencies to allow reports to be passed to the headquarters station VK1BP.

The World Scout Bureau, Geneva, has suggested that the starting time be 0001 hours local time Saturday 16th October and terminate 48 hours later, ie, 2359 hours local time Sunday, 17th October, 1976.

The event is not a contest. Each station is free to select its own times and periods of operation.

All local regulations relating to the amateur service must be adhered to. Listen before you call "CQ Jamboree", to ensure that the frequency is not in use.

The 25th World Scout conference designated 1976 as "Scout Communications Year" and the symbol designated by the conference has been incorporated in the 1976 J-O-T-A emblem.

The official world Scout station, HB9S (Geneva), will operate around the following frequencies:

Band	Phone	CW
80 Metre		3595kHz
40 Metre	7090kHz	7030kHz
20 Metre	14290kHz	14070kHz
15 Metre	21360kHz	21140kHz
10 Metre	28990kHz	28190kHz

It has been suggested by the World Scout Bureau that stations make breaks during long contacts to check if any DX station wants to contact them. During the 1975 J-O-T-A 16 Queensland Rover Scouts visited HB9S but could not break in on Australian stations they could hear, because of lack of listening breaks by Australian and other stations.

VHF operation should not be overlooked. In the past many troops have had interesting contacts with nearby troops. With the expanding repeater usage contacts over a much further range can be made. Amateur satellites will also add additional interest.

The background of J-O-T-A is interesting. The most recent highlight was the award of the Scout Association's highest award—"The Silver Wolf"—to the founder, Les Mitchell, G3BHK, who in 1948, conceived the idea. It was not until 1958 that his efforts saw the inauguration of the first J-O-T-A. Since then the event has grown until it is now a world wide amateur radio and scouting event.

Noel Lynch, VK4ZNI, Australian National J-O-T-A organiser, extended congratulations to Les on behalf of Australian scouts and amateurs. Here is an extract from Les's reply.

"You may be interested to learn that the actual presentation took place on St. George's Day, 23rd April, 1976 at Baden Powell House, London, and was made by our chief scout, Sir William Gladstone.

"On the following Sunday I was privileged to attend the annual parade of Queen's Scouts at Windsor Castle which was reviewed by HRH the Duke of Kent. This was followed by a service in the 500 year old St. George's Chapel where award holders were allowed to sit in pews normally reserved for Knights of the Realm. This was a very imposing service during which the entire congregation re-affirmed their scout law and promise."

Refering to the commencement of J-O-T-A in 1958 Les's comments were:

"This arose from the wonderful assistance received from scouts, radio amateurs and headquarters staff around the world. As Australia has always been a leading country where J-O-T-A is concerned I would like you all to feel that part of this particular 'Silver Wolf' really belongs to you as, without your help, this award would not have been made."

Incidentally, Les Mitchell spent some time in Sydney, Australia around 1945. During that period he was Sea Scoutmaster for a year with the 1st Leichhardt Sea Scouts and spent many weekends camping down the south coast at Austinmer and Thirroul. Les operates G3RSS during his lunch hour and would welcome calls from any Australian stations that may hear him.

The spirit of fellowship and the value of amateur radio as a means of international communication was expressed by delegates of 86 countries at the 25th Scout Conference. Meeting in Copenhagen the conference noted that J-O-T-A annually involves some 6000 amateur stations in 70 countries with participation by more than 100,000 members of the scout and guide movements.

A resolution titled "Cooperation with Amateur Radio Services" was carried and the 25th World Scout Conference requested all member organisations to—

1. Urge their governments to resist any attempt to reduce the number and size of frequencies presently allotted to the amateur radio service and
2. Cooperate with their national amateur radio organisations in actions designed to this end.

Surely this is the type of outlook towards amateur radio that should be fostered, particularly in view of the pressures most likely to be met, in relation to amateur frequency allocations, at the World Administrative Radio Conference in 1979.

On this aspect alone, apart from the personal pleasure to be gained from participating in J-O-T-A, amateurs are urged to contact local scout or guide groups and offer their services, even for a short period, during J-O-T-A weekend.

RADIO CLUB DIRECTORY

Do not let your radio club miss this opportunity to publicise its location, meeting place etc. See August issue of these notes for format details.

This is the final reminder for 1976.

Do not delay—write now. Amateur radio needs to be publicised throughout the community.

REMEMBRANCE DAY CONTEST

The annual Remembrance Day Contest, organised by the WIA, was held on the 14th and 15th August, 1976, A large amount of activity was heard on the bands and several high contact numbers were among those heard being exchanged.

The opening address, recorded by the Prime Minister of Australia, the Hon. Malcolm Fraser, broadcast over all official stations, was introduced by Ted Pearce, VK1AOP, president of the Australian Capitol Division, WIA.

The following is a transcript of Mr Fraser's address:—

"I am very pleased to be given the opportunity to open the Remembrance Day contest for 1976, and in a small way assist in your tribute to the amateur radio operators who laid down their lives for Australia.

"Since the Remembrance Day Contest is a friendly contest, those who take part will be carrying on the tradition of amateur radio itself.

"Making friends over the air and helping to develop international understanding through this remarkable leisure activity, is a most fitting way to perpetuate the memory of those whose names are inscribed on the honour roll.

"I am a little disappointed that amateur radio is not allowed in some countries. But, I understand that most of you listening will be in regular contact over the air with amateurs in most countries of the world; your contacts providing valuable addition to goodwill and international understanding, so badly needed in today's world.

"Your administrators and amateur radio should continue to be on the alert to meet new challenges. The achievements of amateur radio operators are considerable. They include technical advances, constructional assistance to aspiring amateurs and those starting their careers in electronics, demonstrations of using and commanding amateur satellites are just a few.

"Communications originated by amateurs during the Guatemala earthquake and other disasters bear witness to their intrinsic value.

"Here at home the value of amateur communications during cyclone Tracey, the Brisbane floods, bushfires and other emergencies are duly recognised by emergency organisations and official bodies.

"I commend this kind of community effort to all amateurs and hope every advantage will be taken of practice exercises, training sessions and other ways to maintain a high standard.

"With these few thoughts I am delighted to declare open the 1976 Remembrance Day Contest."

AMATEURS ASSIST IN AN EMERGENCY

Amateur radio and the Newcastle channel 6 repeater, VK2RAN, were the means of rapidly obtaining assistance for the victims of a serious road accident on Sunday 1st August, 1976.

About 6.00pm EST, a two car accident occurred on the Pacific Highway about 50 metres south of the Fraser Park turnoff between Doyalson and Swansea. Jim Cleary, VK2ZMC operating mobile while returning to Newcastle from Gosford, had just made con-

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

tact through the repeater VK2RAN with Keith Howard, VK2AKX, when he arrived at the scene of the accident which had only just happened.

Enquiries quickly indicated that an ambulance was needed as well as police to direct and control traffic. The request was passed to VK2AKX who made the necessary telephone calls. An ambulance arrived at the scene about twenty minutes after the call. Two police cars and a second ambulance arrived a little later. Five persons were injured in the accident, two being stretcher cases.

Because of the comparative isolation of this part of the highway, there may have been considerable delay in obtaining assistance without the aid of amateur radio.

Expressions of thanks have been passed to Jim, VK2ZMC, Keith, VK2AKX and his second operator Paul for handling the emergency traffic willingly and capably. Also to other amateurs who monitored the repeater frequencies and kept the channel clear while it was needed for emergency traffic.

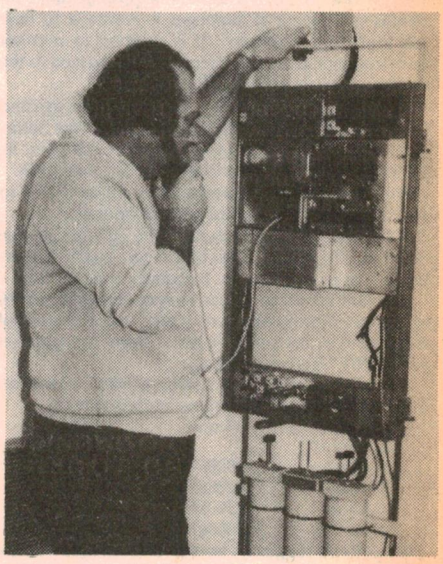
This is an example of the service amateur radio can willingly give to the community.

RADIO CLUB NEWS

WAGGA DISTRICT RADIO CLUB: With good average attendances at the regular monthly meetings and new members joining, the WDRC is making good progress. Currently courses for the novice and LAOCP amateur licence are being conducted.

The Wagga repeater, VK2RAG (channel 3) is providing very good coverage over most of the Riverina—MIA and Murray areas. The rate of usage has increased and mobileers travelling via the Hume, Olympic or Newell Highways can rely on many contacts through VK2RAG.

Most towns within 200km and mobiles around 80km in most directions can now easily gain access to the system. Many other areas gain access under favourable propagation conditions.



Doug Menneke, VK2ZMP, checking out the Wagga repeater at Mt. Flakeney during installation in June 1976.

The installation, shown in the photograph, is located at Mt. Flakeney. It is basically a Phillips—TCA 1677 base station modified for repeater use. Twin aerials are used. One 'ARRL type" cavity filter is used in the transmitter coaxial feeder and two in the receiver coaxial feeder.

In a note, Sid Ward, VK2SW, publicity officer WDRC, said, "With the RD contest now behind us, the next major on air activity will be the Jamboree-on-the-Air. Various social activities are planned for the remainder of the year. These include hidden transmitter hunts, visits to places of technical interest,

films and a dinner-dance evening to involve the ladies."

For further details about WDRC, write to PO Box 71 Kooringal, Wagga 2650, or drop into a monthly meeting on the last Friday of each month in the Wagga Rescue Clubrooms. Visitors and new members welcome.

ILLAWARRA AMATEUR RADIO SOCIETY: The Illawarra WICEN group held a very successful exercise on Sunday 25th July, 1976. Held in conjunction with the Illawarra Vintage Car Club the exercise took the form of convoy escort communications. Nine mobile units took part and activities were co-ordinated by Jim Potts, VK2BBG acting as WICEN control. Communication was on two metre FM channel 40 and IARS mobiles were required to report position and progress of the IVCC vehicles.

Moonbounce report; A scheduled EME test was made on the 3rd July, 1976. Those present were Lyle Patison, VK2ALU, Charlie Proctor, VK2ZEN, Ken Grimm and Eric Jamieson, VK5LP.

The first test was with SM5LE who gave VK2AMW an "M" (most letters copied) report. Due to auto ignition interference was only a "T" (odd letters copied) report could be given to SM5LE.

The next test was with PA0SSB when "M" reports were exchanged. The final test was with LX1DB but signals were not heard, except VK2AMW's echoes which were peaking at 7dB above the noise.

On the 30th July, 1976 contact was made with SM5LE when signals were "M" copy both ways.

On the 1st August, 1976 a special test was carried out with HK1TL operating portable in Columbia, South America. However, no signals were heard. All the moonbounce equipment, antenna and personnel for the test from HK1TL came from W3CCS, the Mt. Airy VHF Radio Club, Philadelphia, USA.

A QSL card confirming the first EME contact with VK2AMW has been received from W1JAA. The point-to-point distance is 16270km. WK2AMW operates on 43MHz band from Dapto, NSW.

AMATEUR IN AIR RACE

Dick Smith, of Dick Smith Electronics, will be flying his Piper Twin engined Commanche aircraft—reg VH-DIC—in the Australian air race from Perth to Adelaide, Melbourne and Sydney from October 20th to the 24th.

He will be operating continuously on all two metre amateur channels using an FDK Multi 7 feeding a quarter wave whip (call sign VK2ZIP).

Dick will be on the lookout for contacts and will QSL with an attractive 'air race' QSL card. He will make an award for the contact with the longest communication distance (we hear one amateur is setting up on Ayers Rock!).

Co-Pilot for the race will be famous Australian aviatrix, Nancy Bird-Walton. If you are planning to travel to a remote mountain top write to Dick first and he will listen for you.

Route segments are as follows:
October 20th – start Perth – Norseman-Forest. October 21st – Forest – Cedwa – Port Augusta – Adelaide. October 22nd – Adelaide – Camerai – Warrnambool – Melbourne. October 24th – Melbourne – Narrandera – Parkes – Bathurst – Sydney.

GEELONG AMATEUR RADIO-TV CLUB: In a report published in the August, 1976 issue of the GARC newsletter, the club president Hayd'n Chittock, VK3BFL stated—"It has been the concern of the club for some time that, although the population of Geelong has expanded in recent years, the amateur population has remained dormant. This situation should not be tolerated by Geelong amateurs; we must have the numbers if we are to survive and enjoy our hobby. To do this we, as amateurs, must support schools, clubs and organisations who support amateur radio.

"This year the club is to take a step in promoting amateur radio by conducting classes for the novice level amateur licence. These classes will be open to the public and wil be conducted by qualified teachers."

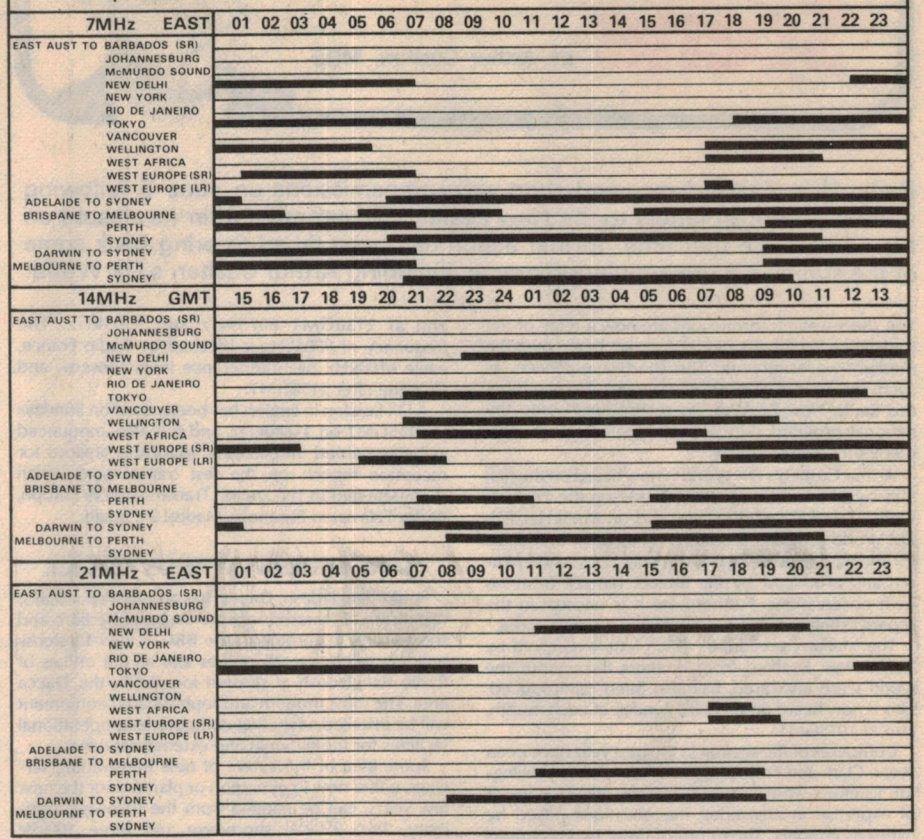
Membership of the club is not a pre-requisite for enrolment in the classes.

Contact GARC Public Relations Officer, Alan Bradley, VK3LW, PO Box 520, Geelong 3220, or telephone 437 550; for more details.

Meetings are held each Friday night in the clubrooms, Storrer Street, East Geelong.

IONOSPHERIC PREDICTIONS FOR OCTOBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 10.76



AUSTRALIAN CAPITAL TERRITORY DIVISION WIA: A new look for their monthly newsletter. The July 1976 issue is a 14 page, 24cm by 16cm photo-offset printed. The contents include a resume of coming activities, thought provoking guest editorial, WICEN notes, technical details of the Canberra repeater Mk II duplexer, and advertisements from radio trade houses.

Amateurs residing in the VK1 call area who have not already become a member of the ACT division are invited to join and add their support to promotion of amateur radio status in the ACT. Those interested in becoming amateurs are also catered for.

Write to WIA, ACT Division, PO Box 1173, Canberra City, ACT 2601 for details.

CENTRAL COAST AMATEUR RADIO CLUB: Plans are already in hand for their field day to be held on 20th February, 1976. This event draws the largest attendance of amateurs, families, and friends in Australia. Make plans to attend.

Here are some details of the CCARC repeater VK2RAG operating on channel 3. The transmitter and receiver are valve type and, in order to cut down the power bill, the repeater control system closes down the transmitter if not used for eight minutes.

The repeater turn on procedure is:
1. Transmit a burst of carrier with your call sign,
2. If the repeater does not come on immediately wait for four seconds.
3. The repeater will come on automatically and transmit its call sign, channel number, and time (EST), in Morse code using a 960Hz tone at 15wpm. It is then available for use by adequately modulated transmissions.

A frequency checking circuit allows users to set their transmitting frequency in the centre of the repeater receiver bandpass. To use this facility it is necessary to provide a strong signal to the input of the repeater for about five seconds including identification. If the signal to the repeater is plus or minus 1.5kHz a tone burst will be heard. If the frequency was low a 630Hz burst is transmitted or if a high 1400Hz tone transmitted. No tone indicates that your transmitted frequency is within the bandpass.

Operators should note that an adequate level of speech modulation is necessary to ensure proper operation of the system. Persistent button pushing will cause the repeater to automatically switch off until sufficient amplitude and duration of speech resets it. Time out is 4 minutes.

WAIT AMATEUR RADIO CLUB: Members of the West Australian Institute of Technology Radio Club are looking for contacts on 14.170MHz on Wednesday afternoons at 2.00pm; 3.00pm and 4.00pm West Australia standard time (0600GMT; 0700GMT; 0800GMT). Also on Wednesday evenings on 14.170MHz and 3685kHz at 8.00pm and 9.00pm (1000GMT and 1100GMT).

CQ calls will be made for five minutes at the above times from the club station VK6PD.

Shortwave Scene

by Arthur Cushen, MBE

Radio New Zealand resumed short-wave transmissions on June 5 following a wave of protest letters to the New Zealand Government after its closure on May 1st. Since that time, further action has been taken to bring back some of the station's more popular programs, including Arthur Cushen's DX World.

The short-wave transmissions are now a relay of the Radio New Zealand National program heard over the medium-wave network. The shortwave service, as such, had no special inserted programs. To overcome this Radio New Zealand has reintroduced onto the national program two popular sessions heard formerly on shortwave only.

Arthur Cushen's DX World is now heard on the first Sunday of each month at 1015GMT on the YA Network of Radio New Zealand, and on 6105kHz. This DX World program is unique. It has been broadcast for the past 16 years, and is the only DX Session written and broadcast by the listener himself from his own observations. Furthermore it is unusual in the broadcasting field, as it is read from a Braille script.

The Mailbox session, in which letters received by Radio New Zealand from listeners throughout the world were answered, has also been reintroduced. This is now heard on the third Sunday of each month, also at 1015GMT.

Comperes of the session in the past year have been Bryan Clark and Tony King, two well known Wellington listeners whose knowledge has added a touch of expertise in answering the questions posed by overseas listeners. The return of these two programs will be welcomed by short-wave listeners throughout the Pacific and Australia. The present schedule is as follows: to the Pacific 1800-2000GMT 9770, 11780kHz; 2000-0050GMT 11960kHz; 2000-0450GMT 15130kHz, 0100-0450GMT 11705kHz; 0500-0700GMT 9540kHz, 0500-1030GMT 11780 or 6105kHz and to Australia 0700-1030GMT 6105kHz.

RECENT VERIFICATIONS

GRENADA: Radio Grenada has confirmed our reception on 15105kHz with a card. The present schedule is 3300kHz 2205-0230GMT, 9550kHz 1545-1800GMT, and 15105kHz 1945-2200GMT. The power on all frequencies is 5kW and the address is Radio Grenada, Broadcasting House, St George's, Grenada, West Indies.

SRI LANKA: The Sri Lanka Broadcasting Corporation confirmed reception with a coloured card showing a native girl. Our reception was for reports on 3385 and 11800kHz. The verification was signed by J. N. Heath, Superintendent Engineer, Sri Lanka Broadcasting Corporation, Colombo 7, Sri Lanka. The frequency of 11800kHz is used 0300-0830 and 1330-1730GMT, while 3395kHz replaces 3385kHz 0015-1730GMT.

SPAIN CONTINUES TESTING

Madrid has been heard on three frequencies on a test basis with its new transmission to Europe in English 2030-2130GMT and with the same program repeated at 2130GMT. The transmissions were first noted on 5955kHz, then on 6075kHz. The most recent frequency used is 6100kHz. The station is announcing that at 2030GMT they are using 9505kHz and at 2130GMT 6075kHz and 9505kHz. The frequency of 9505kHz is blocked by Radio France, while 6100kHz has interference from Moscow and Cologne after 2130GMT.

A DX Session in English has been noted on Sundays at 0145GMT on 11880kHz, and it is also announced as being carried on 6065kHz. Madrid is anxious for reception reports on the test transmission which should be sent to The English Transmission to Europe, Radio Television Espanola, Madrid 24, Spain.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are in GMT. Add 8 hours for WEST, 10 hours for EAST, and 12 hours for NZT.

BANGLADESH EXPANDS SERVICE

Radio Bangladesh, Dacca, has announced a major expansion of its radio services on both medium and short-wave. According to the BBC, a new 12-storey building will house 25 studios and all the offices of Radio Bangladesh at present located in the Dacca area. The most modern and sophisticated equipment will be installed, including computerized operational facilities for the national and external services.

Some idea of the extent of new transmitting services, either now in operation or planned for the next few years, can be gauged from the following summary. Two 250kW shortwave and three 100kW medium-wave transmitters are to be installed within the next two years. These, together with the recently inaugurated 1,000kW medium-wave transmitter in Dacca, will cover the entire country with national and regional programs. They will also make it possible for several external service programs to be broadcast simultaneously to "friendly nations to the east and west".

The regional stations of Radio Bangladesh at Chittagong, Khulna and Rajshahi, which at present have 10kW medium-wave transmitters, will each have a 100kW transmitter installed, enabling them to reach shipping in the Bay of Bengal when storm warnings are broadcast. In addition the Chittagong station will broadcast programs for the tribal people residing in the Chittagong Hill Tract Region.

Under its development plan, Radio Bangladesh will set up independent broadcasting organizations in Khulna, Rangpur and Sylhet and in this connection the transmitter power of the Sylhet station is to be increased from 2kW to 20kW. Work is progressing on six FM transmitters to improve reception of the VHF service.

SWISS UPGRADES SERVICE

The Swiss Broadcasting Corporation at Berne has come a long way since 1938, when Swiss Broadcasting Corporation's first regular short-wave broadcast was sent out over a 25kW transmitter at Schwarzenburg, just a few miles from the studios in Berne.

Today, the Swiss Post, Telephone and Telegraph Administration (PTT) operates five different short-wave broadcast stations, the newest being at Lenk and Sarnen. These new SBC voices are each 250kW and completely automated—two of the most modern short-wave facilities in Europe. Along with the older installation at Beromunster, these stations operate omni-directionally in the 75, 49 and 31 metre bands.

Bridging the longer, overseas gap between studio and listener are the directional installations at Schwarzenburg and Sottens. The Sottens station near Lausanne, consist of a 500kW transmitter and a huge, rotatable curtain antenna—one of the few types in the world.

In its continuing program of modernization, the Swiss PTT is currently starting out on an ambitious plan to replace three, old 100kW transmitters at Schwarzenburg with the same number of 250kW transmitters. These will supplement two other 250kW transmitters, which have been in service for several years. In addition, a new multi-band, multi-directional antenna will be built, giving the Schwarzenburg signals the boost they need to better serve their listeners in the remotest corners of the globe.

Berne has two English transmissions to Australia and New Zealand and these are broadcast 0700-0730 and 0900-0930GMT. This service is broadcast on 9590, 11775, 15305 and 17840kHz. A later transmission 1315-1345GMT is beamed to Western Australia and carried on 11775, 15430, 17830 and 21520kHz. Swiss Merry-Go-Round is broadcast on the second and fourth Saturdays, and contains technical information for the short-wave listener.

VILA USES 4975kHz

Radio Vila in the New Hebrides has been noted using 4975kHz at 0120GMT by Dene Lynneberg of Wellington. It is presumed that this frequency replaces 7260kHz for the transmission 0030-0200GMT.

Radio Tanafo has made a frequency change to 3990kHz and has now been heard with English announcements at 0800GMT. The station broadcasts from Santo and uses the power of 60 watts. It operates from 1930-2030 and 0730-0830GMT, although at times the latter has been extended to 0900GMT.

LISTENING BRIEFS

MONACO: Trans World Radio at Monte Carlo has been heard on the new frequency of 5945kHz with a program in German at 0440GMT. This frequency and program appears to be new. The transmission lasts 30 minutes and leaves the air at 0510GMT.

PORTUGAL: Libon has introduced a further transmission in English, heard from 0500 to 0530GMT on 6025kHz. The signal is fair, but there is severe interference from Radio Kuwait also on 6025kHz.

EAST GERMANY: Radio Berlin International has been noted on 15125kHz from 1200 to 1245GMT. This English transmission is reported by Frank Proepster, Hove, SA. According to the announcement transmissions to East Asia include 0645-0730GMT 15240 and 17800kHz; and 1200-1245GMT 11965, 15125, 21540KHz.

NORWAY: The latest transmission schedule of Radio Norway, Oslo, gives details on the use of the new 250kW transmitter: 0100-0230 and 0300-0430GMT on 6180kHz, 0500-0630GMT on 11870, 0700-0830GMT on 15135, 1100-1230GMT on 6015, 1300-1430GMT on 15345, 1500-1630GMT on 15175, 1700-1830GMT on 11860, 1900-2030GMT on 15175, 2100-2230GMT on 15345, and 2300-0300GMT on 9645kHz.

SWEDEN: Radio Sweden continues to relay the home program for reception in Australia and New Zealand 0630-0800GMT. A frequency change has been made and 9605kHz replaces 11705kHz. At the same time the transmission is beamed to Europe on 6065kHz and to Africa on 15390kHz. Other changes in the English schedule include 1830-1900GMT on 11790kHz replacing 15240kHz; 1600-1630GMT on 9665kHz replacing 9650kHz and 11740kHz replacing 15240kHz.

NORTH KOREA: Radio Pyongyang has been heard on two new frequencies with the English Service at 1000GMT. The frequencies are 7203 and 9768kHz, and both give good reception. The old channel of 9420kHz has been replaced by 9768kHz, but at 2000GMT, when a further broadcast in English is received, 9420kHz carries the programme.

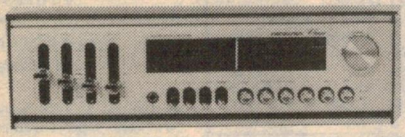
IRAN: Radio Tehran has been noted in English at 2030GMT on the new frequency of 11770kHz. John Mainland of Wellington NZ reports reception at 1930GMT in French and at 2000GMT in English.

TAIWAN: The Voice of Free China, Taipeh, is using only one frequency to Australia reports Bill Vogel of Adelaide in DX Post. They are using 11825kHz 0200-0300GMT and 0300-0400GMT for the English broadcast.

136 VICTORIA RD., MARRICKVILLE, NSW 2204 PHONE 51-3845

A.C.E. RADIO

SOUNDESIGN AM-FM STEREO RECEIVER



Features ● Slide controls for Volume, Balance, Treble and Bass Loudness control—Hi and Lo Filters ● Push-button function switches ● Blackout or Lighted Slide Rule Dial ● Front and Rear Speaker Outlets (8 ohms) for quad. effect ● Brushed Aluminium front panel ● Attractive cabinet.

Stereo Headphone Input, AFC Control ● Specs. ● 5 Watt RMS per ch. ● Aux 400 MV Tape Out 100 MV ● Ceramic Cart, 300 MV ● Mag. 5MV ● Provision for 300/75 OHM Aerial

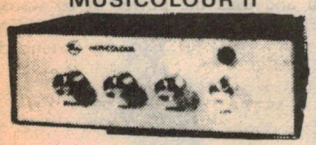
SPECIAL $96.00 p.p. $3.75 W.A. $5.75

PLAYMASTER 25 + 25 STEREO AMPLIFIER

Complete kit of top quality parts **$89.00**. Fully constructed **$118.00**. P.P. N.S.W. $3.50, interstate $4.50.

Chassis and cover only **$16.95** p.p. $3.50. Brushed aluminium front label **$7.30** p.p. $1.20. Printed circuit board **$4.95** P & P $1.00.

MUSICOLOUR II



Magical Colour Organ operates in conjuction with your home stereo or PA system—simple to connect and operate. 3 channels, 1,500 watt max load per channel.

Complete kit of parts **$59.50**
Constructed ready to operate **$69.50**
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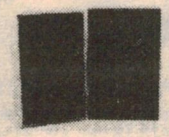
MUSICOLOUR MK.3

Complete Kit of Parts **$69.50**
p.p. $3.50 W.A. $4.50

PLAYMASTER 3-45L
LOUDSPEAKER SYSTEM



Features the mighty 8-30 woofer. 6J midrange and the incomparable Philips AD016/T8 tweeter. This top quality low cost 3 way hifi system is available from stock in either walnut or teak veneer and complies with the specs. as per April '75. **$84.00** ea.

1" THICK INNERBOND
2.50 SQ. YD. P.P. $1.00

C-B 27MHZ COMMUNICATION EQUIPMENT

GEAR TO SUIT BUSHWALKER, FISHERMAN, CAR, TRUCK, BOAT OWNER

Model NC-310. Features 3 channels. Battery checker, squelch control, tone call switch, external aerial, speaker and power jacks, battery charger jack, spec. 13 transistors, RF input power, 1 watt. TX freq. Tol ± 0.005%. Tone call freq. 2000 HZ, RX. Sen 0.7UV at 10dB SN, sel 45dB at ± 10KHZ. If freq. 455 KWZ

$49.95 complete with book and circuit, p.p. $1.60 interstate $2.95.

Model 2 Mobile. 6 channel 5 watts. 14 transistors, 8 diodes, squelch control, sig. strength/RF meter, microphone, book and circuit, 12 volt operation. Size 4¾" WX 1½" HX 6-⅜" d. **$99.00** p.p. $2.50 interstate $3.50.

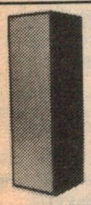
Aerials base station ringo $54.00 p.p. $3.50

Mobile model 27R—stainless steel whip with centre loaded coil. No holes required.

Has strong magnet base, tested to 200 MPH wind, install and dismantle in seconds. Length 27" with 11" 52 ohm cable, freq. 26.5/27.5 MHZ.

VSWR, less than 2. **$29.95** p.p. $2.50.

SOUND SYSTEMS—SLEEK AND SLENDER FOR COMMERCIAL OR HOME HI FI



Black Vinex Covered Cabinets Rugged and Attractive Innerboard Lined for Richer Sound. Excellent Frequency Response 8 or 16 ohms. Floor or Wall Mounting. 3 Models.

15W RMS	25W RMS	40W RMS
2 SPEAKERS	4 x 6" SPEAKERS	4 x 8 HEAVY DUTY
Size 19½"H. 11"W.	33" x 10" x 8"	SPEAKERS
7" D.	**$49.00**	37" x 12" x 8"
$35.00		**$65.00**

E-TONE 60 WATTS RMS LOUDSPEAKER

30cm (12") 8 and 15 ohms VC dia. 5.1cm. Big 3KG magnet. Freq. 40-7000 Hz for bass guitar. Organ. Guitar weight 4.5 Kg. **$45.00** p.p. $3.50.

Send S.A.E. for price & data of other models incl. 38 CM 100W.

WE REGRET THAT PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE.

TV-FM BOOSTER

The Power Booster is designed to operate either one, two or three sets off one aerial for improved reception.

SPECS gain one set.
10db 54.88mhz 6.5db 174-216mhz.
Two sets 5db. 54-88mhz. 2db 174-216.
Three sets. No signal loss 54-216mhz.
Input/output 300 1hms. **$23.95**
Power 240v 50hz. Pack and Post $1.50

GARRARD MODEL 82

A superb 3 speed transcription changer/player. Auto/manual operation 4 pole magnetically shielded syn. motor. Resiliently mounted. Counterbalanced. Elegant tone arm with slide-in cartridge carrier calibrated. Antiskate. 265mm (10½"). Aluminium platter. Cue and pause control. Cartridge tilting lever. Magnetic cartridge diamond stylus. Size 375 x 335 x 170mm (14¾" x 13¼" x 6¼") 4.5kg (10 lbs) P & P $2.50. Interstate $3.50.

$57.00.

GARRARD CHANGER/PLAYER

MODEL—6400 3 speed auto manual changer—player 2 spindles. Motor 2 pole 240V 50Hz 10½" turntable cue and pause, tubular section pick up arm, Sonatone cartridge, Great value **28.50.**

Mounting base and perspex dust cover for either model **$28.50**. Send S.A.E. for more details.

NEW MODEL MAGNAVOX SPEAKERS

10-40 10" base 15 and 8 ohms **$20.95**. 625 6" mid range 8 ohms **$14.95**. XJ3 dome tweeter **$7.80**. Famous 8-30 8 ohms **$14.95**. Magnavox 3 way cross-over for 10-40, 625 and 2 XJ3 **$19.50**. P & P N.S.W. $1.40. Interstate $2.20.

HI FI CABINET KITS

Do it yourself—big savings. Our kits are extra easy to finish. Top, bottom, each side and back are factory assembled, baffle is pre-cut. Veneered pyneboard. Teak or walnut. Complete with innerbond and speaker grille cloth. 8-30. 3-45L, 3-41L systems. **$48.00** pair.

MV-50 system **$65.00** pair.

MAGNAVOX WIDE RANGE TWIN-CONE SPEAKERS

8-16 OHMS	30-16,000Hz
6WR MK5 12W RMS	**$9.90**
8WR MK5 16W RMS	**$10.75**
10WR MK5 16W RMS	**$12.65**
12WR MK5 16W RMS	**$14.95**

p.p. NSW 95c, Interstate $1.50

SANYO CALCULATOR RECORDER OFFICE MACHINE

N.B. Both the calculator and recorder can be operated at the same time.

$78.00
p.p. $2.50 WA $4.50.

An 8 digit electronic calculator with bright easy-to-read fluorescent tube display and cassette recorder with sensitive in-built condenser mic. Also external mic with lead, in a single portable AC/DC unit. Ideal for business conferences, meetings. Specs. Power 240VAC 50HZ. DC.4XUM1. Size 10" WX 9"D x 2-⅜" H. WT. 5lbs. Cal. display, multiplex tube with zero suppression, fully floating decimal point system, functions + — x ÷ %. Basic, constant, reciprocal, cals. Cass! Recorder. Double track, AC bias, DC erase, speed 4.75 CM/SEC. 4" 8 OHM speaker.

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BRAND NEW STOCK TO CLEAR

Rola C4D 4" 3.5 ohm	$1.40
Rola 4D 4" 3.5 ohm	$1.30
Jap 4" 15 ohm	$1.20
Rola 5" x 4" 15 ohm	$1.95
Magnavox 5" x 3" 33 ohm	$1.40
Magnavox 6" x 4" Midrange 33 ohm	$2.25
Magnavox 6" x 4" 33 ohm	$1.50
MSP 6" x 4" 15 ohm	$2.00
MSP 6" x 4" 3 ohm	$1.90
Magnavox 7" x 5" 27 ohm	$2.25
Magnavox 6" 2.7 ohm	$2.40
Magnavox 6AX Twin 8 ohm	$4.50
Rola 6H 6" 15 ohm	$3.40
Rola 6" Twin 15 ohm	$4.00
Rola 8HOO 8" 15 ohm	$4.50
Rola 9" x 6" Twin 8 ohm	$5.50
Magnavox 8JX Twin 27 ohm	$4.50
Magnavox 8ER Twin 27 ohm	4.50
Tesla 10" x 6" 8 ohm	$4.50

SANYO NI-CAD

Rechargeable Batteries
Type A Penlight. **$1.85** ea. 4 for **$6.90**.
Type C **$3.20** ea. 4 for **$11.50**.
Type D **$3.65** ea. 2 for **$6.80**.
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Clear Plastic Front, 120 x 110 M.M. Barrel Dia. 8.5MM.
Stock Clearance Prices.
30 AMP DC, 10A DC. 1A DC. 500 VDC, 500 VAC, 300 VAC, 15 VDC, 10MA, 1 MA NO SCALE.

$6.50 each P.P. 90c
v.u., 500UA, 100UA **$8.50**

POWER TRANSISTORS

2N441, 2N442 3 FOR **$2.00**

EX SURPLUS RADIO GEAR TO CLEAR

BC.221 frequency meter, 1.25-20MHZ. Complete with calibration book and crystal **$35.00.**

240VAC power supply to suit BC221 **$15.00.**

Mullard CTA20 valve tester (no cards) operates off 240VAC.

Included is 3" Mullard, display CRO tube. **$25.00.**

APN-1 RA IO altimeter, with wobulator as used for sweep generator **$10.00.**

Test set for APN-1, model TS-161-APN **$47.50.**

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BC-929 radar indicator unit with 3BPI CRO tube, shield and socket **$17.50** bendix. Left/right indicator IN41. **$3.75.**

No. 19 250 watt RF amplifier 12VDC $17.50. AWA. RF signal generator type 17R 7490. 140-300 MHZ. 240VAC powered **$69.00.**

Plessey wireless set B47, 39-56 MHZ. Complete with 240VAC supply and speaker **$57.50.**

120VAC, 60HZ, 1PH. 2500W, lighting plant coupled to 4 CYL. 6.5HP coupled to 4 CYL. 6.5HP petrol engine. 1½ gal per hr. **$350.00.**

Stop fading, use an ex-RAAF dual diversity adaptor 2 x 3A, crystal controlled local oscillator, 240VAC, 1.5/32MHZ. DC-11 455 HC crystal **$27.50.**

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25MFD 440 VAC 3½" x 3 x 5H	$3.50
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BC221 FREQUENCY METERS

Brand new in original packing cases—unopened complete with 240 volt power supply. Charts, etc. $90 each—cartage to rail $1. Freight payable at nearest attended railway station.

P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$35.00
(2 TELEPHONE SETS)

$1 cartage to rail. Freight payable at nearest attended railway station.

TEN CHANNELS VHF TRANSCEIVER

TR1956 125-150 MHz. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator.

$33.00

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T.U. Series. Contains variable condenser suitable for aerial tuning, vernier 5" Ceramic Coil Former, etc. 19" rack mounting, only $9.50 ea. Post A. $2.30, B. $3.75, C. $4.80, D. $6.55.

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AN URM 32 A 120 KHz to 1000 MHz, with 240V power supply, $125
$1.00 cartage to rail, freight payable at nearest attended railway station.

ILFORD 17.5 mm SPROCKETED MAGNETIC TAPE

1000 ft reels brand new original packing
$4.00 ea. quantity
available

Post A $1.30, B. $2.00, C. $2.30, D. $2.80.

No. 62 TRANSCEIVER

With headphones, accessories etc.
$60

TELEPHONE WIRE

1 mile twin (2 miles) genuine ex-Army Don 8 perfect condition $35 per drum $1 cartage to rail freight payable at destination.

PRISMATIC COMPASSES

Genuine ex-army Mk 3, liquid damped, as new $45.00 P & P A. $1.70, B. $2.25, C. $2.40, D. $2.65.

MORSE KEY $1.40 Post 40c | **MORSE KEY BUZZERS** $4.25 Post 60c.

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Provides a visual indication of signal output. Tests: electrode open circuits, short circuits, current gain. **$14.95 ea.**
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MULTIMETER

A compact and handy tester for workshop or lab where quick circuit checks are required
DC Voltage 5-2.5K (20,000 OHMS per volt) AC Voltage 10-1000V (10,000OHMS per volt) DC Current 0-50 UA, 0-2.5 MA, 0-250 MA. Resistance 0-6 Megohms Decibels — 20 to plus 22 DB. Complete with instructions.

Only $17.25 ea. Post $1.05.
30,000 ohm per volt. **$23.75** P & P $1.05

BENDIX PIONEER

Drift Sight
Type B3
$250.00

4 DIGIT RELAY COUNTERS

50 volt DC, suit slot car Lap counters, etc.

$1.25 each. P & P 60c.

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Cuts sheet metal like a punch and die, trims, notches and cuts to any size or shape over 7/ 16inch.

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1.2 Volt, fully charged, 4in x 3in x 1in 4 AH.
$1.50 each. P & P 60c.

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Decadade oscillator. Type DG 38A
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Produces an Audio Signal in rich harmonics. Ideal for Sig Tracing in A.F., I.F., and R.F. circuits. Powered by 4 Penlight Batteries with On-Off Switch and indicator lamp. Size 1½" Diam. 5" Long. Only
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25 x 30 **$6.50**
P & P A. $1.70, B. $2.25.
C. $2.40 D. $2.65.

SMALL CLIP-ON POCKET TELESCOPE

15X $3.95 Post 60c

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60 magnification with a 60mm coated objective lens with tripod.

$75.00
as illustrated

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C. $3.20, D. $3.95.

WALKIE TALKIES 2-WAY RADIO, PMG APPROVED

1 watt, 11 transistor **$130.00** set of 2.

P & P A. $1.80, B. $2.50, C. $2.80, D. $3.20.

SMALL COMPUTER PANELS

3in x 2in containing 2 valves, qty of resistors, etc.
ONLY 75c. P & P 60c.

ELECTRONIC FREQUENCY COUNTER

Austronic type DFC-4 240V 50 cycle 0-100KHz **$150**

IMPELLER PUMPS

New gunmetal body, Stainless Steel Shaft. Neoprene Impeller. Up to 15ft. Lift, suitable for almost any type of liquid. Self priming. Ideal boat bilge pump, sullage drains, etc. Approx size 8" x 5"

⅜" **$23.30**
½" **$31.95**

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RECEIVER No. 210

2-16 M/cs **$65.**
Transmitter No. 11 suits 210 **$35.**
24 volt Power supply to suit above **$15.**
Or complete station with Headphones, Mic, Morse Key, Antenna **$110.**

LAVOIE FREQUENCY METER Fr-/6U

100 to 500 M/HZ
240 Volt operated
PERFECT CONDITION
$375.00

522 Transceivers 100 150M CS

$35.00

5" CRO TUBE

5 BPI **$5.50** each.
Post A. $1.40, B. $2.25, C. $2.70, D. $3.45.

POSTAGE KEY:

A: NSW.
B: Vic, Qld.
C: SA, NT, Tas, New Guinea,
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BRAND NEW IN CARTONS

65N7GT	95c	CV850	$1.50
5U4G	95c	1H6G	75c
EF50	75c	832	$5.00
5Y3	$2.25	6X4	$2.25
2 x 2	75c	VR64	75c

P & P 40c

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Genuine eight day jewelled movement sweep second hand. Dash mounting. $29.50 EA. P. & P. $1.10.

CONDENSER LENS

1½" Diam 4½" F.L. 75c 2½" Diam 2" F.L. $1.50 each. Or $2.50 per pair. P & P 40c

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30 x 30 $23.95 — 45 x 40 $36.50

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8 x 17 mag size of a rifle cartridge extends to 8". Only $4.75 each, post 60c.

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PRISMATIC Coated Lenses. Brand new. Complete with case.

7 x 35 Wide Angle	$35.50
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7 x 50	$31.50
10 x 50	$32.50
12 x 50	$33.65
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SOLENOIDS

Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio, etc.
$2.50 P & P 20c
200 MA 24 volt, ⅛in push movement.
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SELSYN MOTORS MAGSLIP

MK 11 ..... $5.25 ea.

3000 TYPE RELAYS

P.M.G. 200Ohms — 1'500Ohm
Coils **$2.50** each. P & P 60c.

P.M.G. TYPE KEY SWITCHES.
45c P & P 20c

Cintel Oscillator and Electronic Counter, type 388.

$250

SPECIAL lucky dip valve offer, 15 new valves in cartons for only $2.95. We haven't got time to sort them, so you reap the benefit.
P & P A. $1.80, B. $2.50, C. $2.80, D.

RADAR TRANSCEIVER

X BAND WITH KLYSTRON ETC. **$45.00**

PANORAMIC ADAPTOR

E.M.I. type PRA-1 455 variable Kc
Course 440-520 Kc
Centre Freq 520-440 Kc
Fine Centre Freq 20-0-20.
Filter band with 50, 100, 200 L.F.
200 H.F. Sweep band width 0-200.

$75.00.

TRANSCEIVERS Ex Army

No C42 set, 36 to 60 MHz complete with 24V power supply, headphone, mic, leads etc **$65.00.**

No C45 set, 23 to 38 MHz complete with mast, headphones, mic, 24V power supply etc. **$95.00.**

$1.00 cartage to rail, freight payable at nearest railway station.

Hartley double beam oscilloscope. Type 13A with probes.
Working **$150.00**

77D x RCA STUDIO RIBBON MICROPHONES Variable pattern & response music or speech $80.00 ea. Post A $3.30 B $4.00 C $4.30 D $4.80.

EX-ARMY TWO-WAY FM RADIOS

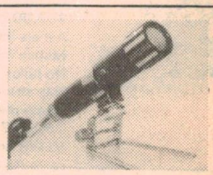
1.2 WATTS OUTPUT
SUPERHET
PRC9 AND 9A 27 to 39 M/HZ
PRC10 AND 10A 38 to 55 M/HZ
COMPLETE WITH HANDSET
ANTENNA AND BATTERY
ONLY **$25** EA
P&P A$2, B$4.50, C$4.50, D$6.35

16MM SOUND PROJECTORS IN GOOD WORKING ORDER

240 volts operated. Complete with Speaker and Amplifier.

CINEVOX **$150.00**
BELL & HOWELL **$250.00**
SIEMENS **$375.00**

$1 Cartage to Rail. Freight payable at nearest attended Railway Station.



MICROPHONES OMNI DIRECTIONAL 50K OHMS

FREQ. RESPONSE 100-10,000Hz
Sensitivity 56dB complete with 5ft cable. Microphone Holder and Stand Base only $7.95 ea.
P&P A$1.70, B$2.25, C$2.40, D$2.65.

REPERFORATOR

Genuine Siemens Type 33c **$65.00**

Deitch Bros.

70 OXFORD STREET, SYDNEY 2010

SORRY NO C.O.D

INFORMATION CENTRE

PLAYMASTER TWIN 25: I have just read your interesting articles on the 25 watt per channel amplifier and was particularly interested in the preamplifier using a 741 IC plus two extra transistors, to combat the noise level of the 741. I am enclosing a cutting from the English magazine "Popular Electronics" which describes a new Ferranti IC, ZN424, which may be of interest to you.

Also the loudspeaker protection circuit using a relay is interesting, but I am wondering if you have ever thought of using SCR crow-bar protection. According to overseas writers this is ever so much quicker in action than fuses and relays.

Finally, how about extending the tone controls to include a midrange control with a choice of roll-off for the bass and treble, as in the Sansui and other amplifiers. I do not remember any local circuits ever going beyond the usual bass and treble.

I have been an interested reader of "Electronics Australia" for about 26 years and always enjoy the hifi articles. (G.S., Preston, Vic.)

• Thank you for your favourable remarks. At this stage we have not seen the specifications for the new Ferranti device so we cannot comment further.

While it is true that SCR "crow-bar" circuits can act very fast, especially when protecting power supplies, the normally used Triac "crow-bar" circuit to protect loudspeakers against faults in DC coupled amplifiers is, in practice, not appreciably faster than the relay circuit we have used. This is because the main factor which determines the circuit operating speed is the low pass filter which is necessary to distinguish between large AC output signals and DC fault conditions.

Moreover, there is a serious drawback involved with loudspeaker protection circuits of the crow-bar type: Suppose for example, a fault occurs in the amplifier which causes the output of the amplifier to present a large DC voltage to the loudspeaker. This may or may not be due to a blown output transistor. The fault condition normally means that one of the output transistors is fully conducting (while the other is either damaged or turned off). The Triac crow-bar circuit merely puts a short-circuit across the loudspeaker line to remove the DC voltage condition—and in doing so, burns out the fully conducting output transistor.

Thus the repair bill is bigger than it would have been if a relay protection circuit was used. To our knowledge, crow-bar circuits are not used any more. The relay circuit is more satisfactory (it does not blow components unnecessarily) and it can incorporate switch-on and switch-off muting.

As far as midrange tone controls are concerned, we are dubious as to whether they are worth the extra complexity. Variable turnover points for the bass and treble controls are easily provided, merely by switching the relevant capacitors. To lower the bass turnover frequency, the .047uF capacitor across the bass control potentiometer should be increased; similarly, to raise the treble turnover frequency, reduce the .0068uF capacitors in series with the treble potentiometer.

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Dyeline transparencies, actual size but of limited contrast: $2. Specify positive or negative. We do not sell PC boards.

REPLIES BY POST: Limited to advice concerning projects published within the past 2 years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Only as available. Within last 6 months, face value. 7-12 months, add 5c surcharge; 13 months or older, add 10c surcharge. Post and packing for 60c per issue extra.

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COMMERCIAL SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia".

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

INFORMATION CENTRE

DYNAMIC RANGE ENHANCER: Congratulations on a very fine magazine. As a student on a limited income and a budding hifi enthusiast I appreciate your excellent articles dealing with the construction of good quality hifi components.

I have built the Playmaster 144 cassette deck, Twin 25W stereo amplifier and the excellent 3-41L speaker system and I am very impressed with their performance. However, may I make a suggestion as to what might be a very popular project amongst record users?

How about an article describing the construction of a dynamic range enhancer? I have seen and heard commercial units and been very impressed with their operation. (J.P., Alderley, Qld.)

● A number of integrated circuits for use in dynamic range enhancers have recently become available, and we hope to produce a suitable circuit using these in the near future.

NOTES & ERRATA

TRANSISTOR ASSISTED IGNITION SYSTEM (August 1975, File No 3/TI/13): The BDY98 is now obsolete. Suitable substitutes are the higher rated BDY97 or BDY96. We also suggest that a 220 ohm ½ watt resistor be connected across the three-diode string to ensure that T1 and T2 are positively turned off.

SYNC-A-SLIDE (June 1976, File No. 2/MS/40). The FET (TR7) is incorrectly designated as 2N3640. This should be 2N4360.

AMENDED 50 Hz CRYSTAL DRIVE (July 1976, File No 7/CL/23): The zener diode in the mains-powered version is shown reverse-connected.

ASCII-Baudot . . . from p. 89

machine by either looking at the type-bar heads, or running it in local and typing out each of the keys in alphabetic order, in both lower case (LTRS) and upper case (FIGS.) Either way, you can compare the results with the coding type-out shown in Fig. 4, which is that assumed by the translator.

The translator itself does make one minor decoding error, which proved difficult to obviate. It affects only the "at" or "per" sign (@), occurs only during ASCII-to-Baudot translation (i.e., during printing), and even then not every time.

You will find that whenever the character occurs immediately following figures or other upper-case Baudot characters, it will be translated and printed correctly. However, when it occurs immediately following letters, you will find that it will be mis-translated and printed as a G—its lower-case Baudot equivalent.

The reason for this error is that in ASCII code, the "at" sign is effectively an alphabetic character—it has the same coding for the three most significant bits as do the first 15 letters. However, in Baudot code, where the character is present, it is regarded as an upper-case character or "figure".

Full processing of the character by the translator program would involve not only recognising and translating its code, but also performing the Baudot case checking and modification procedure which the program does with all other printing characters. This would involve sending the appropriate "FIGS" character ahead of the character itself, if the printer happened to be in letters mode.

This proved to be rather difficult, so I ended up compromising. The "at" sign is correctly translated into the appropriate 5-bit Baudot code, but is otherwise treated like one of the non-printing characters like space, carriage return or line feed. This means that the program does not perform the usual case checking or modification, because in Baudot code the non-printing characters are "caseless"—they are the same in both cases, and hence do not affect printer case mode.

When you're using the translator and a Baudot machine with a system, remember that the translator buffer can only cope with an accumulation of 240 characters. So if you want the system to print out a long hex listing or some text, do it in modest slabs.

If you forget and try printing out a large character string, you'll find that the translator will "lose" 240-character chunks of the string, due to the buffer

input pointer having overtaken the output pointer. This causes no problem to the translator, but it does foul up your print-out! So if you find that chunks of a printout are missing, simply try again with the system delivering the characters in smaller strings.

By the way, the use of a code translator inevitably involves a time delay in either direction—mainly because characters must be fully strobed in before they can be translated and then sent out again. This means that when characters are keyed in from the teleprinter keyboard there is a noticeable delay before they are echoed by the printer. The delay is particularly noticeable when the computer system itself echoes on a complete-character basis, giving a total "round trip" delay time of around 450 milliseconds.

This takes a little getting used to, but it is one of the prices one pays for using a teleprinter which "speaks a different language".

Finally, a word on using Baudot teleprinters with computers. Baudot machines were developed around 1906, long before electronic digital computers were a reality. Presumably their designers didn't anticipate that anyone would ever want to use them to send lots of mixed letters and numerals, so they adopted the system of using "letters" and "figures" modes, with the two special case-change keys used to change back and forth between modes as required.

It won't take you long to realise that this makes the machines quite clumsy when it comes to keying in programs in hexadecimal code. You'll have to develop the habit of always sending "LTRS" before you want to key in letters, and always sending "FIGS" before keying in figures.

The technique takes a while to get used to, and even then it is mildly irritating—especially if you are used to working with the more elegant ASCII machines. Still, Baudot machines have one big advantage—they're available, and they're cheap!

STOP PRESS: SC/MP GETS "TINY BASIC"

Just as this issue was going to press we received some happy news from NS Electronics regarding the SC/MP low cost development system described in our story on pages 78-81. By the time you read this, NS distributors should be able to supply a PROM card for the LCDS with a version of "Tiny BASIC".

No price information was available at the time of writing, but we understand that the program fits in 6 512-byte PROMs—i.e., 3k.

This news should be of particular interest to those seeking a way of getting into higher level programming at moderate cost.

We hope to give more details in a later issue.

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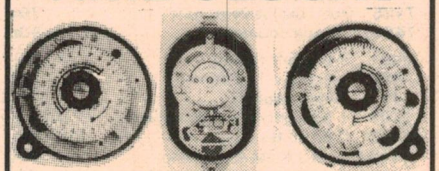

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